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Medication-assisted treatment vs. detoxification for women who misuse opioids in pregnancy: Associations with dropout, relapse, neonatal opioid withdrawal syndrome (NOWS), and childhood sexual abuse

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ABSTRACT

The American College of Obstetricians and Gynecologists recommends medication-assisted treatment (MAT) for pregnant women who misuse opioids rather than detoxification because of possible relapse and dropout from treatment (ACOG, 2017). In a prospective study, fifty-five pregnant women with an opioid use disorder were offered a choice of MAT or detoxification. Ethical concerns precluded random assignment. We assessed dropout, treatment outcome, relapse, other illicit drug use, infant neonatal opioid withdrawal syndrome (NOWS), and childhood sexual abuse. Of 55 women, 13 initially chose MAT and 42 women chose detoxification. All women received behavioral support. No one dropped out of treatment prior to delivery. All women who chose MAT initially remained on MAT. Of women who chose detoxification, 23% switched to MAT, 30% tapered below initial MAT doses, and 45% fully detoxified by delivery. There was a significant difference in opioid relapse between women on MAT (26%) and those who detoxified (0%), but no differences for other illicit drug use. Infants of women on MAT were more likely to have neonatal NOWS (91%) than infants of women who tapered below initial MAT doses but did not fully detoxify (62%). Infants of mothers who tapered (62%) were more likely to have NOWS than infants of women who fully detoxified (0%). Women on MAT reported significantly lower sexual abuse severity than did women who tapered or detoxified. It is critical to replicate the current findings and to follow up with mothers and their infants postpartum to ascertain the long-term impact of tapering or detoxification during pregnancy.

1. Introduction

Women and their children bear a significant burden from the opioid epidemic (Bianchi & Gillman, 2019). The number of women who misuse opioids in pregnancy more than quadrupled between 1999 and 2014 (Haight, Ko, Tong, Bohm, & Callaghan, 2018), making determination of appropriate treatments a high priority to safeguard the health of both the mother-to-be and her infant (Stuart et al., 2018). The recommended treatment by the American College Obstetricians and Gynecologists (ACOG) for women who misuse opioids in pregnancy is medically assisted treatment (MAT; also called opioid agonist pharmacotherapy): women are maintained on doses of opioids high enough to prevent withdrawal symptoms and dampen cravings, yet low enough to prevent euphoric effects (ACOG, 2017). MAT reduces the risk of relapse and

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improves adherence to prenatal care compared with brief (3- or 7-day) inpatient detoxification (Jones, O'Grady, Malfi, & Tuten, 2008). Although detoxification in pregnancy presents no apparent risks to the fetus (Bell et al., 2016), concern remains about relapse rates of 50–90%, and subsequent noncompliance with prenatal treatment (ACOG, 2017).

1.1. MAT vs detoxification in pregnancy

Many women who misuse opioids in pregnancy report high motivation to use the transition to parenthood to detoxify from opioids for their own health, to avoid infant Neonatal Opioid Withdrawal Syndrome (NOWS), and to avoid stigma (Cleveland & Bonugli, 2014; Frazer, McConnell, & Jansson, 2019). Both MAT and illicit use of opioids are associated with NOWS, which raises the average cost of delivery from $3,500 to $93,400 (Patrick, Davis, Lehmann, & Cooper, 2015). Moreover, NOWS may present risks for infants' brain development beyond the temporary distress of detoxification at birth (Caritis & Panigrahy, 2019). However, whether or not there are long-term effects of NOWS is not clear due to the challenge of disentangling the effect of opioids in utero from later environmental factors including other drug exposure in pregnancy, sociodemographic risk, and maternal mental health (Conradt, Crowell, & Lester, 2018). Some studies found long-term effects for NOWS on cognitive development, motor development, and behavioral symptomatology, but failed to control for important environmental variables (Beckwith & Burke, 2015; Fill et al., 2018; Konijnenberg, Sarfi, & Melinder, 2016; Nygaard, Moe, Slinning, & Walhovd, 2015; Oei et al., 2017; Sandtorv et al., 2018). Other studies found that differences attributed to exposure to opioids in utero disappeared when environmental controls were added (Hans & Jeremy, 2001; Kaltenbach et al., 2018; Konijnenberg, Lund, & Melinder, 2015; Konijnenberg & Melinder, 2015; Messinger et al., 2004).

However, two studies found effects of opioids that did *not* disappear with appropriate controls: significant effects on cognitive and motor development (Nygaard, Slinning, Moe, & Walhovd, 2017), and on inhibitory control and working memory (Levine & Woodward, 2018). Moreover, head circumference at birth is smaller for infants with NOWS: 30% had a head circumference below or equal to the 10th percentile, and 8% had a head circumference below or equal to the 3rd percentile, effects not due to exposure to other drugs (Towers, Hyatt, et al., 2019). A smaller head circumference may potentiate future problems with cognitive development. However, the long-term effects of a smaller head circumference have yet to be determined in prospective studies.

Full detoxification from opioids during pregnancy offers the potential to eliminate NOWS. ACOG acknowledges the safety of detoxification during pregnancy, but given limited data currently recommends MAT, citing high relapse rates, the danger of accidental overdose due to loss of tolerance, and dropout from prenatal care (ACOG, 2017). To be successful, detoxification may need to be gradual rather than the brief 3- or 7-day protocols tested by Jones and colleagues (Jones et al., 2008). In the current study, women who chose to detoxify did so gradually over weeks or months, depending on the starting dose. Due to ethical concerns with limiting a woman's choice, we did not assign women randomly to treatment condition. Randomly assigning women to either MAT or detoxification, although scientifically more rigorous, would be problematic due to restricting a woman's choice that affects both her and her infant (Unger et al., 2011).

1.2. Childhood sexual abuse and opioid use in pregnancy

The question arises: for which women might detoxification in pregnancy be successful? It is important to determine factors associated with successful detoxification to help women and their physicians make an informed choice. We focused on the experience of childhood sexual abuse. There is a relationship between childhood abuse and opioid misuse in young adulthood (Austin, Shanahan, & Zvara, 2018). Moreover, the experience of sexual abuse is associated with substance misuse in women in general (Kendler et al., 2000) and with opioid misuse specifically (Conroy, Degenhardt, Mattick, & Nelson, 2009). Furthermore, for 411 women who misused opioids in pregnancy, more women (53%) reported that their drug use began with childhood sexual abuse (prior to the age of 13 for 54% of cases), than for any other type of maltreatment, chronic pain, or other factor (Towers, Katz, et al., 2019). In the current study, we therefore examined associations between a history of sexual abuse and treatment outcome, i.e., whether pregnant women were categorized in the MAT, taper below initial MAT doses, or detoxification group at delivery.

1.3. Objectives of the current study

This study was designed to examine pregnant women in a clinic for opioid misuse who were given a choice between MAT and detoxification. We assessed dropout from treatment, treatment outcome, opioid relapse, use of other drugs, NOWS, and women's reports of sexual abuse severity in childhood. Due to the absence of research in this area, we did not have specific hypotheses regarding outcomes at delivery or the association between childhood sexual abuse and these outcomes.

2. Method

2.1. Participants and procedures

Physicians referred women to the high-risk pregnancy clinic for opioid misuse from June through November in 2017. We enrolled 55 pregnant women from a high-risk pregnancy clinic at a university medical center and followed them prospectively to delivery. All procedures were standard: nothing was changed for this study. Women were eligible for the study if they had a high-risk pregnancy due to opioid misuse, were over 18 years old, and were in their second trimester or beyond. We retrieved information about initial appointment information prior to recruitment from medical records. Medical staff had asked women at their first appointment about when and why they thought they had initiated drug use, e.g., following childhood maltreatment, or after being prescribed opioids for physical pain. In consultation with their physicians, women were offered a choice of treatment: MAT or gradual detoxification. Women consulted with clinic physicians to decide on treatment after an informed discussion held in a nondirective manner (i.e., women were given the choice of treatment). Patients were told that research finds that tapering off opioid medications during pregnancy does not appear to be harmful to the fetus and does not increase the risk for pregnancy complications. They were also told that there are two main risks. If they try to taper doses of their opioid medication, there is always a risk that they could relapse. Furthermore, if they were to relapse to a drug that is stronger than can be tolerated, this could lead to overdose and death. However, women were also told that chronic opioid use throughout the pregnancy can lead to fetal dependence, resulting in a need for treating NOWS in some newborns postdelivery. In addition, research shows that some of these neonates have smaller head circumferences at birth compared to their peers, and some have learning and behavioral problems that extend into childhood. However, these risks to the newborn/infant/child are not universal, Medical staff provided behavioral support to all women, e.g., during their visits to the clinic and in the form of daily text messages and phone calls from a certified peer counselor e.g., to adhere to prescribed opioids only, and to find transportation to attend appointments. In addition, all women were referred to a behavioral treatment program for women who misuse opioids in pregnancy (180 Health Partners, 2019). When a woman arrived for her appointment, a receptionist asked if she was interested in taking part in a 30-minute study on high-risk pregnancies. If she was interested, a nurse brought her to a private examination room where a research assistant explained the study purpose and procedures, answered any questions she might have, and reviewed the consent form. Following informed consent, the research assistant

administered questionnaires. The mother received a $25 gift certificate as compensation for the time taken to participate. We accessed medical records to follow women throughout their pregnancy and delivery.

2.2. Measures

2.2.1. Demographics

We collected demographic information from medical records. See Table 1. We used receipt of Medicaid as a proxy for low socioeconomic status. All participants received Medicaid, which is a joint federal and state program to help with medical costs for individuals with limited income. Pregnant women qualified for Medicaid if their income was below 160% of the federal poverty level (US Department of Health and Human Services, 2016).

2.2.2. Opioid use

We used medical records to confirm women's opioid misuse status from urine assays and confirmed their prescriptions for buprenorphine, buprenorphine plus naloxone, or methadone. Women initially chose MAT or detoxification. Those who chose detoxification tapered off opioids over a period of weeks or months, depending on their tolerance for decreasing doses. Not all women who chose detoxification tapered completely. Some tapered below MAT doses of prescribed opioids and some stayed on standard MAT doses (8–16 mg for daily buprenorphine; 50–120 mg for daily methadone).

2.2.3. Dropout

We reviewed medical records for dropout from treatment before delivery, defined as no longer attending prenatal care appointments.

2.2.4. Treatment outcome

We created a categorical treatment outcome variable assessed at delivery from medical records. A score of "1″ indicated that women were on MAT at delivery, the MAT group; a score of "2" indicated that women had tapered below initial MAT doses by delivery, the taper group; and a score of "3" indicated that women had fully detoxified off opioids, both prescribed and non-prescribed by delivery, the detoxification group.

2.2.5. Maternal drug use at delivery

We used infant urine and meconium assays in medical records to assess maternal drug use at delivery. An infant is not discharged until he or she has passed his or her first feces, which is termed meconium. Urine is collected in a plastic bag attached to the genital area. Meconium is removed from a diaper and sent to a lab for assay. Infant urine can detect maternal drug use for the past 4–7 days and meconium can detect maternal drug use during the last 4 to 5 months of pregnancy, whereas a maternal urine test would only detect maternal drug use in the past day or two. However, a negative result does not exclude the possibility that a mother used drugs during pregnancy. Alcohol and nicotine were not included. See Table 3 for drugs found by group. We derived two variables: relapse and other drug use. We created a *relapse* variable based on the presence of non-prescribed opioids in infant urine and meconium, where "0″ = no relapse and "1" = relapse. We created a variable for *illicit drugs other than opioids* in infant urine and meconium, e.g., cannabinoids, benzodiazepines, methamphetamine) where "0" = no other drugs, and "1" = other drugs present.

2.2.6. NOWS

After delivery, nurses monitored infants using Finnegan scores to assess the severity of withdrawal symptoms (e.g., continuous high-pitched cry for longer than five minutes, generalized convulsions, moderate-severe tremors when undisturbed) using the standard checklist protocol for clinicians and researchers designed to provide uniform criteria for the assessment and treatment of NOWS (Finnegan, Connaughton, Kron, & Emich, 1975). Infants were observed four times a day, and those who received two consecutive Finnegan scores $\geq$ 10 or one Finnegan score $\geq$ 12 were classified as having NOWS. We created a dichotomous NOWS variable assigning a "1″ for "yes" and a "0" for "no."

2.2.7. Childhood sexual abuse

Women completed the Maltreatment and Abuse Chronology of Exposure (MACE Teicher & Parigger, 2015), which is a 52-item questionnaire that assesses severity of maltreatment experienced before the age of 18. The MACE was related to other measures of trauma in childhood as expected (Bernstein et al., 1994; Dube et al., 2003), but accounted for more variance in psychiatric symptoms than did the other measures. The MACE demonstrated excellent test–retest reliability, and the subscales fit the model well. In the current study, we used the sexual abuse severity variable (7 items).

2.2.8. Data analytic strategy

Treatment outcome group differences on demographic variables were assessed using a univariate analysis of variance (ANOVA) for the continuous variable (age), and chi square tests for the categorical variables (minority ethnic background, employed, partnered). Treatment outcome group differences on variables of interest were similarly tested with an ANOVA for the continuous variable (sexual abuse severity) and chi square tests for categorical variables (dropout, opioid relapse, other drug use, NOWS),

3. Results

3.1. Preliminary analyses

We tested for demographic differences between treatment outcome groups (MAT, taper, detoxification). There were no significant differences, so it was not necessary to control for demographic variables in subsequent analyses. See Table 1.

Thirteen women initially chose MAT, and 42 women chose detoxification. At delivery 23 women were in the MAT group, 13 were in the taper group, and 19 were in the detoxification group. Of the women in the MAT group at delivery, 13 made the choice of MAT initially, and 10 switched from detoxification to MAT. All women in the taper and detoxification groups initially chose detoxification. All women

Table 1
Demographics in the Whole Sample and by Treatment Outcome Group, $N = 55$.

	Whole Sample $N = 55$	Maintain Group $n = 23$	Taper Group $n = 13$	Detoxification Group $n = 19$	Group Differences
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*F (df)*
Maternal age (years)	28.22 (4.37)	28.99 (3.78)	29.35 (3.36)	26.52 (5.27)	2.33 (2,52)
	n (%)	*n* (%)	*n* (%)	*n* (%)	χ^2
Minority ethnic background	4(7)	2(9)	1(8)	1(5)	0.91
Employed	8(15)	3(13)	3(23)	2(11)	1.05
Has partner	20(36)	8(35)	7(54)	5(26)	2.57

All women received Medicaid.

underwent urine assays regularly with a median of 8 in the MAT group, 10 in the taper group and 10 in the detoxification group. The average prescribed dose of buprenorphine in the MAT group at delivery was 8.1 mg and the average dose for methadone was 110 mg. The average dose for buprenorphine in the taper group at delivery was 2.7 mg. Fifty-one percent of women in the sample reported experiencing sexual abuse in childhood.

3.2. Treatment outcome differences

No women dropped out of treatment prior to delivery. In terms of opioid relapse, in the sample as a whole, 13% of women ($n = 7$) relapsed. See Table 3 for drugs used in relapse. More women who were on MAT at delivery relapsed (26%) compared with women who detoxified (0%), but there were no significant differences between MAT (26%) and the taper group (8%). In terms of other drug use, in the sample as a whole, 22% of women ($n = 12$) had used other illicit drugs. There were no significant treatment group differences on drugs other than opioids (23% in the MAT group, 23% in the taper group, and 16% in the taper group). In the sample as a whole 53% ($n = 29$) of infants had NOWS. Infants of women on MAT were more likely to have NOWS (91%) than were infants of women who tapered below MAT doses (62%) or than were infants of women who detoxified (0%). Moreover, women on MAT reported significantly lower sexual abuse severity than did women who tapered or detoxified. For all analyses there were no significant differences between women whose initial choice was to maintain on MAT ($n = 13$) and women whose initial choice was to detoxify but who were on MAT at delivery ($n = 10$). See Table 2 for tests of treatment group differences.

4. Discussion

This study was the first to assess treatment outcomes for women who misuse opioids in pregnancy that include MAT, tapering below MAT doses, and full detoxification. The study examined treatment outcomes for women who, in consultation with their physicians, initially chose MAT (24%) or gradual detoxification (76%). By the time of delivery, all women who initially chose MAT remained on MAT. Among women who chose detoxification initially, 24% had switched to MAT by delivery, whereas 31% had tapered below MAT doses, and 45% had fully detoxified.

4.1. Dropout and relapse

No women dropped out of treatment prior to delivery. Moreover, the overall rate of opioid relapse during pregnancy in the current sample as a whole was low (13%). The highest rate of opioid relapse during pregnancy (26%) was for women who were on MAT at delivery, which was significantly higher than for women who detoxified (0%). Eight percent of women who tapered during pregnancy relapsed on opioids. These percentages are much lower than relapse rates of 50–90% during pregnancy cited by ACOG for women who attempt to detoxify (ACOG, 2017).

There may be two reasons for the absence of dropout in the current study. First, we recruited women in their 2nd or 3rd trimester. If recruited earlier in pregnancy, some women may have refused any treatment and dropped out: One study found that 8% of women fell into this category (Towers, Katz, Weitz, & Visconti, 2020). Second, women had the support of their medical providers in a stigma-free environment. The American Society of Addiction Medicine (ASAM, 2017) reported that pregnant women with substance use disorders often experience stigmatization and discrimination from healthcare providers. ASAM (2017) recommended a conversation between clinician and patient about substance use following a positive toxicology screen, and noted that the manner in which the conversation is conducted may be an important factor in motivating women to make positive changes. In the current study, an understanding of the origins of opioid use as part of this conversation, e.g., from the experience of childhood sexual abuse, may have facilitated the motivation to enact positive change. However, motivation to change was not assessed and might usefully be the focus of future research.

Two factors may have contributed to relatively low relapse rates. First, the individualized nature of treatment may have made it more likely that women would be successful versus a "one size fits all" approach to MAT or detoxification. Second, all women received peer counseling and additional behavioral treatment was available, which may have helped women comply with substance misuse treatment and address sexual abuse history. Indeed, a women-specific program for pregnant women with opioid use disorder improved outcomes (Krans et al., 2018) and in a qualitative study, peer counseling was found to be advantageous, which women received in the current sample (Fallin-Bennett, Elswick, & Ashford, 2020). The clinic is organized specifically around issues for pregnant women with a substance use disorder with behavioral treatment is a key component. However, in this study, individual level data on number of contacts with the peer recovery specialist or engagement in the behavioral treatment program were not available. Thus, the effects of behavioral treatment on treatment outcome are unknown, and would be an important topic for future research.

4.2. Other illicit drug use

There were no significant differences between the three treatment groups in the presence of non-opioid illicit drugs (e.g. cannabinoids, benzodiazepines, methamphetamine) at delivery. Twenty-two percent of women tested positive for other illicit drugs. This is considerably higher than percentages reported from a national survey in 2016, which reported that only 5.1% of pregnant women used illicit drugs other than

Table 2
Treatment Outcome Group at Delivery and Dropout from Treatment, Opioid Relapse, Other Drug Use, Infant NOWS, and Women's Childhood Sexual Abuse, $N = 55$.

	Whole Sample $N = 55$	Maintain Group $n = 23$	Taper Group $n = 13$	Detoxification Group $n = 19$	
	n (%)	*n* (%)	*n* (%)	*n* (%)	χ^2
Dropout	0(0)	0(0)	0(0)	0(0)	0
Opioid relapse	7(13)	6(26)[1]	1(8)	0(0)[2]	6.76*
Other drugs	12(22)	6(23)	3(23)	3(16)	0.66
NOWS	29(53)	21(91)[1]	8(62)[2]	0(0)[3]	34.33***
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*F (df)*
Sexual abuse severity	1.87 (2.83)	1.35[1] (2.10)	3.46[2] (3.67)	3.42[2] (3.45)	3.21* (2,52)

Note. *$p < .05$; ***$p < .001$. Group differences are indicated by different superscripts.

Table 3
Relapse: Illicit Drugs in Infant Urine and Meconium at Delivery, $N = 55$.

	Whole Sample $N = 55$	Maintain Group $n = 23$	Taper Group $n = 13$	Detoxification Group $n = 19$
	n (%)	*n* (%)	*n* (%)	*n* (%)
Amphetamines	5(9)	2(9)	2(15)	1(5)
Barbiturates	1(2)	0(0)	1(8)	0(0)
Benzodiazepines	4(7)	2(9)	2(15)	0(0)
Cannabinoids	4(7)	2(9)	0(0)	2(10)
Oxycodone	4(7)	3(13)	1(8)	0(0)

opioids in pregnancy and 1.2% used illicit opioids (Center for Behavioral Health Statistics and Quality Substance Abuse and Mental Heatlh Services Administration, 2017). The discrepancy may be due to the use of self-report questionnaire methodology in the national survey compared with infant urine and meconium assays in the current study. Illicit drug use during pregnancy may be more widespread than previously recognized.

4.3. NOWS

The incidence of NOWS in infants was greatest in the MAT group (91%), which was significantly higher than in the taper group (62%), which in turn was significantly higher than in the detoxification group (0%). Reduction in NOWS via tapering or full detoxification has benefits by relieving the financial burden (Patrick et al., 2015), by lessening stigma (Cleveland & Bonugli, 2014), and by avoiding separation of mother and infant for detoxification, which may impede bonding (Newman et al., 2015). However, detoxification may leave women vulnerable to relapse. It is crucial to follow these women postpartum to assess their status with respect to opioid use: do they continue to abstain, start MAT, or turn to illicit drugs? There will likely be variability in postpartum outcomes and again it will be immensely important to assess factors associated with each one to inform preventive interventions.

4.4. Childhood sexual abuse

Women on MAT reported significantly lower sexual abuse severity than did women who tapered and women who fully detoxified. Acknowledgment of childhood victimization as a factor in initiation of drug use, i.e., that women are seen as victims rather than as perpetrators against their unborn children, may prevent stigma and help women build a trusting relationship with healthcare providers. Women may then learn how to understand and tolerate painful mental states following their maltreatment history, which would in turn help them detoxify from opioids. Although not assessed in the current study, women whose drug misuse originated in chronic pain, on the other hand, may not be similarly motivated to change and may choose MAT rather than detoxification. However, efforts to detoxify to stop using drugs do not easily result in long-term recovery for those with a trauma history unless support is provided on an ongoing basis (Chen, Turiano, Mroczek, & Miller, 2016). Interventions need to continue postpartum to prevent relapse. For example, interventions that improve the ability to understand mental states of self and other (reflective functioning) may address the link between childhood maltreatment and opioid use in pregnancy (Macfie et al., 2020).

4.5. Strengths and limitations

Strengths of the study include a prospective design and a stigma-free setting in which pregnant women who misused opioids were given a choice of treatment that included detoxification, which is very rare. MAT may not be appropriate for all women. It is important to identify subgroups for whom detoxification might be a valid option and those for whom MAT is the best choice. Another strength is that data on opioid misuse and other drug use came from infant urine and meconium assays rather than from self-report measures. Moreover, in addition to information on substance use, relapse, NOWS, and treatment outcome, we assessed childhood sexual abuse, the most common factor reported by women in their initiation of drug use (Towers, Katz, et al., 2019).

The current study also has notable limitations. The sample size was small, and replication with larger samples is needed, ideally including multivariate analyses to test a single model as a whole. The lack of randomization to type of treatment means that outcomes may be related to the goals of the women whose chose each treatment. However, it could be ethically problematic to assign women to a specific treatment against their wishes because of the ramifications for themselves and for their infants, and making it less likely women would comply. We did not have historical information on duration and severity of opioid use, which may have influenced outcomes. In a study of pregnant women with opioid use, 61% reported attending a drug treatment program previously, 54% reported that marijuana was the gateway drug and 59% reported that prescribed opioids led to addiction (Towers, Katz, et al., 2019), but accuracy of self-reports concerning drug history, especially under threat of infant removal after delivery, may make truthful reporting difficult (Jackson & Shannon, 2012; Kissin, Svikis, Morgan, & Haug, 2001; Roberts & Nuru-Jeter, 2010). Moreover, we had no individual level data on the behavioral intervention. Thus, we do not know if the women who had been sexually abused in childhood received more behavioral treatment during pregnancy than did others. Furthermore, individual providers may have affected outcomes. In addition, we did not have information regarding participants' diagnostic comorbidity (e.g., posttraumatic stress disorder). We also do not know if women who chose MAT initially or switched to MAT from an intention to detoxify were more likely to have started opioid misuse for reasons other than sexual abuse, e.g., chronic pain. In the future, research would be strengthened if these limitations were addressed.

4.6. Conclusion

Detoxifying from opioids in pregnancy does not appear to harm the fetus (Bell et al., 2016). Moreover, in our sample there was no dropout and minimal relapse. Tapering below initial MAT doses significantly reduced NOWS, and detoxification eliminated NOWS. In a supportive, stigma-free environment, reports of a history of sexual abuse were associated with successful tapering or full detoxification and not with MAT. A pathway to opioid misuse through childhood sexual abuse may be more responsive to detoxification than, for example, a pathway through chronic pain. However, we need to replicate these findings and carefully investigate the process by which severity of sexual abuse might be associated with treatment outcomes. Furthermore, additional research is needed to examine for which subgroups of pregnant women detoxification is likely to be successful, and research following up women who detoxified or tapered postpartum to assess vulnerability to relapse is essential.

CRediT authorship contribution statement

Jenny Macfie: Conceptualization, Formal analysis, Methodology, Writing - original draft, Writing - review & editing. **Craig V. Towers:** Conceptualization, Methodology, Project administration, Writing - original draft, Writing - review & editing. **Kimberly B. Fortner:** Project administration, Writing - original draft. **Gregory L. Stuart:** Writing - original draft. **Bharathi J. Zvara:** Writing - original draft. **Gretchen Kurdziel-Adams:** Conceptualization, Investigation, Data curation. **Stephanie B. Kors:** Conceptualization, Investigation, Data curation. **Samantha K. Noose:** Investigation, Data curation. **Andrea M. Gorrondona:** Investigation, Data curation. **Chloe T. Cohen:** Writing - review & editing.

Declaration of Competing Interest

The authors declared that there is no conflict of interest.

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