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Perinatal Substance Use: A Prospective Evaluation of Abstinence and Relapse

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Abstract

Background—Substance use decreases in pregnancy but little prospective data are available on the rates of abstinence and relapse for specific substances. This study compared rates of abstinence in pregnancy and relapse postpartum for nicotine cigarettes, alcohol, marijuana, and cocaine.

Methods—Data from 152 women drawn from a randomized controlled trial comparing psychological treatments for substance use in pregnancy were analyzed. Self-reports of substance use and urine for toxicology testing throughout pregnancy and 3-months, 12-months and 24-months post-delivery were collected. Multivariate Cox models were used to compare rates of abstinence and relapse across substances.

Results—In pregnancy, 83% of all women achieved abstinence to at least one substance. The mean (SE) days to abstinence was 145.81 (9.17), 132.01 (6.17), 151.52 (6.24), and 148.91 (7.68) for cigarettes, alcohol, marijuana and cocaine, respectively. Participants were more likely to achieve abstinence from alcohol (HR 7.24 (95% CI 4.47-11.72), marijuana (HR 4.06; 95% CI 1.87-6.22), and cocaine (HR 3.41; 95% CI 2.53-6.51), than cigarettes. Postpartum, 80% of women

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abstinent in the last month of pregnancy relapsed to at least one substance. The mean days to relapse was 109.67 (26.34), 127.73 (21.29), 138.35 (25.46), and 287.55 (95.85) for cigarettes, alcohol, marijuana and cocaine, respectively. Relapse to cocaine was only 34% (HR 0.34; 95% CI 0.15-0.77) that of cigarettes.

Conclusions—Pregnancy-related abstinence rates were high for all substances except cigarettes. Postpartum relapse was common, with cocaine using women being less likely to relapse after attaining abstinence compared to women using cigarettes, alcohol or marijuana.

Keywords

Pregnancy; postpartum; drug use; smoking; relapse; abstinence

1. INTRODUCTION

Approximately 11% of reproductive age women use illicit substances, 25% use cigarettes, and 30% binge drink or use heavy amounts of alcohol (Substance Abuse and Mental Health Services Administration, 2013). Pregnancy interrupts the pattern of substance use in many women. Nearly 50% of pregnant women who smoke cigarettes (Tong et al., 2008) and 70-90% of women who use illicit substances (Ebrahim and Gfroerer, 2003; Massey et al., 2011) achieve abstinence in pregnancy. Similar abstinence rates are reported among pregnant women with heavy alcohol use (Massey et al., 2011; Substance Abuse and Mental Health Services Administration, 2013). Offsetting the pregnancy-related decrease in substance use is the precipitous increase that occurs during the 6 months to one year after delivery (Ebrahim and Gfroerer, 2003; Gilchrist et al., 1996; Howell et al., 1999). For example, close to half of women who attain abstinence to smoking in pregnancy relapse within two weeks of delivery (Colman and Joyce, 2003), and 80% relapse within six months (DiClemente et al., 2000).

While existing data consistently illustrate the moderating effect of pregnancy on the course of substance use, most information, with the exception of studies of smoking in pregnancy, is derived from cross-sectional surveys and retrospective reports. Methodologically, it is easiest to focus only on one substance, and thus few studies have compared abstinence across substances. However, it is possible that the addictive properties of various substances differs making it harder for pregnant women to cease the use of one substance compared to another. From a clinical perspective, it would be useful to determine whether the likelihood of abstinence in pregnancy from cigarettes, illicit substances or alcohol is uniformly similar because resources could be devoted to the substances that are more difficult to stop.

It is also unknown whether the risk of relapse after delivery is the same across substances. The majority of research has focused on smoking relapse postpartum (Colman and Joyce, 2003; Gyllstrom et al., 2012; Kaneko et al., 2008; Park et al., 2009; Ruger et al., 2008; Tong et al., 2008; Tran et al., 2013; Yasuda et al., 2013), with only a handful of studies looking at postpartum alcohol relapse (Ebrahim et al., 1998; Jagodzinski and Fleming, 2007a, 2007b; Nayak and Kaskutas, 2004). One of these studies found that at six to 12 weeks postpartum 37.8% of women who were frequent drinkers before pregnancy reported postpartum risky drinking, with 18% reporting heavy episodic drinking, 5% frequent drinking only and 15%

reporting both behaviors (Jagodzinski and Fleming, 2007a). Another study found that women who reported at risk drinking postpartum were almost six times more likely to have had at risk drinking prior to pregnancy (Jagodzinski and Fleming, 2007b). However, there are no studies that evaluated women's patterns for drinking from pregnancy through delivery and into the postpartum period. Very little is known about the relapse process for illicit substance use following pregnancy. The only information currently available on the relapse process postpartum was collected nearly 20 years ago from a cross-sectional national survey (Ebrahim and Gfroerer, 2003).

Prospectively collected data can explore complicating factors such as concurrent substance use, and present a detailed picture of the abstinence and relapse process in perinatal women. The goal of this report is to chart the prospective course of substance use in a cohort of perinatal women with a pre-pregnancy history of substance use, and to compare rates of abstinence and relapse to the various substances, during pregnancy and after delivery. Specifically, the course of cigarettes, alcohol, marijuana and cocaine use in pregnancy and after delivery was examined. Patterns of concurrent substance use during this period were also examined. Data from a psychotherapy treatment trial for pregnant substance using women that included two years of post-pregnancy follow-up were analyzed.

2. METHODS

2.1 Participants

The analytic cohort was drawn from the Psychosocial Research to Improve Drug Treatment in Pregnancy trial, a comprehensive, multicenter, prospective study, which has been described elsewhere in detail (Yonkers et al., 2012). Briefly, data where gathered between 2006 and 2012 as part of a randomized controlled trial to compare drug treatment outcomes for nurse-delivered motivational enhancement therapy (MET) coupled with cognitive behavioral therapy (CBT) and brief advice from an obstetrical provider. Women were eligible to participate if they had not yet completed their 28th week of pregnancy and were at least 16 years of age. Please refer to Table 1 for participant demographic information. Potential participants must have reported use of alcohol or an illicit drug, during the 28 days prior to screening or scored at least 3 on the TWEAK (Chang et al., 1999; Russell et al., 1996), which was modified by adding “and drugs” to questions for alcohol (Yonkers et al., 2010). A score of two or more on the TWEAK indicates a positive outcome for use in pregnant women (Chang, 2001). Women were ineligible if they were already engaged in substance use treatment, were using an opiate as their primary drug, or nicotine as their only substance. Women with primary use of opiates were not offered participation in the parent trial, as the standard of care for opiate use in pregnancy is opiate agonist treatment through centers that provide counseling. While smoking was not an eligibility criterion for the parent study, smoking status and amount was assessed at intake and all subsequent study visits. Women were recruited from three local prenatal clinics affiliated with the Yale School of Medicine, and the study procedures were approved by the Institutional Review Board.

2.2 Data Collection

Women were interviewed throughout pregnancy and postpartum while attending a prenatal or postnatal care visit; a minority of visits occurred at the authors' research offices. Study visits were of two types, treatment and assessment only. The number of treatment visits was unlimited in pregnancy and limited to two postpartum. The average number of treatment visits was six. An analysis of treatment efficacy showed no difference between treatments at three months post the intervention trial (Yonkers et al., 2012). Assessment only visits occurred at intake, delivery, 3-months post-delivery, 12-months post-delivery, and 24-months post- delivery. The 12-month and 24-month visits and data collection were also part of an economic evaluation, the results of which are reported elsewhere (Xu et al., 2014).

2.3 Measures

Participants completed a comprehensive, computerized intake assessment that included the Addictions Severity Index-Lite (ASI; McLellan et al., 1980), the Inventory of Depressive Symptomatology (IDS-SR; Rush et al., 1996), the Mini-International Neuropsychiatric Interview 5.0.0 Clinician-Rated (MINI-CR; Sheehan et al., 1998), and the Substance Use Calendar (SuCal). We used the brief version of the ASI to assess substance related severity and impairment, and elicit information on seven functional areas often affected by substance abuse: medical status, employment and support, drug use, alcohol use, legal status, family or social status, and psychiatric status. The ASI provides information on frequency, duration, and severity of problems over the patient's lifetime and in the past 30 days, and has been extensively studied and shows very good external reliability (0.89), test-retest reliability (0.92), and internal consistency (Cronbach's alpha ranging from 0.62 to 0.87; Hodgins and el-Guebaly, 1992; McLellan et al., 1992). The IDS-SR was administered to gauge the severity of any ongoing mood symptoms. The IDS-SR measures severity of cognitive features of depression/anxiety and reverse neurovegetative symptoms of depression. Despite the fact that the measure is short (28-items), it is comprehensive and has high internal consistency with a Chronbach's alpha of 0.94 (Rush et al., 1996). The MINI-CR was used to generate diagnoses of depression, anxiety disorders (including trauma and stress disorders), psychotic disorders and substance and alcohol abuse and dependence. The MINI-CR is a 120-item, closed-ended instrument developed to assess 17 Axis I disorders and 10 subtypes, along with suicide risk, and correlates moderately well with the SCID (0.43 to 0.90), and the Composite International Diagnostic Interview (CIDI; 0.36 to 0.82) but has the advantage of being shorter and easier to administer (Sheehan et al., 1998). The SuCal was based upon the Time Line Follow Back (Sobell et al., 1996), a calendar method that allows collection of data on individual substances (cigarettes, alcohol, marijuana, cocaine) on a daily basis.

Research staff assessed participants during each of their subsequent prenatal visits after intake assessment. Research staff had a background in maternal mental health and addictions and were further trained on structured psychiatric interviewing, best practices for working as University researchers in a primary care setting, and empathy skills, including a nonjudgmental approach to working with pregnant with a history of substance use. At each encounter the IDS-SR and the SuCal were administered. At intake the SuCal collected daily information on substance use for the previous 28 days, and at follow-up visits data was collected dating back to the previous completed visit. In addition, urine toxicology and

alcohol breath tests were obtained. A commercially available immune-chromatographic test (one-step Status Stik®) was used to detect cannabinoids, cocaine, opiates and their major metabolites in urine. The Redwood Labs Breath Alcohol Test® was used to monitor alcohol use. For biological measures, any detected amount was categorized as positive.

2.4 Development of Substance Use Risk Sets for Analysis

From the intent to treat cohort, the subset of women who met minimum baseline criteria for use of cigarettes, alcohol, marijuana or cocaine in the six months before pregnancy was included. Since a solo diagnosis of nicotine abuse or dependence was not an eligibility criterion of the main study, cigarette use data were only available for the three months prior to pregnancy.

Women who never used a particular substance were not “at risk” for becoming abstinent to that substance since they never used it. Similarly, only women who used a substance before pregnancy and achieved abstinence in pregnancy are “at risk” for relapse postpartum. Because of this, we assessed the likelihood of abstinence and risk of relapse, by substance, after segregating participants into “risk sets”. The abstinence risk sets included all women who had used a substance of interest prior to pregnancy, and thus were eligible for abstinence in pregnancy. The relapse risk sets included participants from the abstinence risk sets that achieved abstinence in pregnancy, and thus were eligible for relapse postpartum. Women could be assigned to more than one risk set if they used more than one substance. Risk sets were built separately for abstinence and relapse, and consisted of one risk set for each of the four substances examined. Thus, there were four risk sets for abstinence and four risk sets for relapse. The women in each risk set comprised the “substance use group” described at the bottom of Table 1. The criteria for inclusion in the particular risk set were the following: five or more cigarettes per day in the three months before or in pregnancy for smoking; seven drinks per week or three or more per day during the six months prior to or in pregnancy for alcohol; any marijuana use during the six months prior to or in pregnancy for marijuana; or any cocaine use in the six months prior to or during pregnancy. The five cigarette minimum was based on the smoking literature in perinatal women (Cnattingius, 2004; McBride et al., 1992; Reitzel et al., 2010; Tong et al., 2008), and used the minimum amount, which allowed us to capture the majority of smokers. For alcohol the National Institute on Alcohol Abuse and Alcoholism definition for at risk drinking in women was used (National Institute on Alcohol Abuse and Alcoholism, 2014). For marijuana and cocaine any use was chosen as the minimum criteria since these are illicit substances for which there are no established guidelines for use and no amount of use is considered safe in the perinatal period.

All women who met baseline substance use criteria were eligible for abstinence and were included in the “Potential Abstinence Cohort.” For the abstinence analysis data from all the pregnancy visits were included. At each pregnancy visit the SuCal obtained information on substance use since the last completed visit. Thus, any substance use from intake through delivery was accounted for. The duration of abstinence was operationalized as the time interval between last use of a substance, beginning at any time in the 28 days prior to intake, and delivery. In order to be considered abstinent, women needed to abstain from use of a

substance for a minimum of one month, and this needed to occur immediately prior to delivery. Therefore, if a woman abstained from substance use for three months in pregnancy and then resumed use of that substance in the month prior to delivery, she would not be considered abstinent. Women with concurrent substance use could have achieved abstinence from one substance and not another. For example, a woman could be considered abstinent in the alcohol risk set, and not abstinent in the cigarette risk set. Thus, women with concurrent use were considered independently in each risk set based on their use of that particular substance. The breakdown of the number of participants in each abstinence risk set can be found at the bottom of Table 1.

All participants who achieved abstinence from a particular substance for a minimum of four weeks prior to delivery were included in the "Potential Relapse Cohort," as well as the relapse risk set for the particular drug. The relapse analysis included data from delivery and the 3-month, 12-month and 24-month follow-ups. Postpartum relapse was defined as the day of first use of any quantity of the baseline drug by a participant following delivery and up to 24 months postpartum, which was the last assessment point for substance use in the study. Similar to the women in the abstinence cohort, women in the potential relapse cohort could be included in different risk sets based on their relapse or continued abstinence to a particular substance. For example, a woman with a history of concurrent cigarette, marijuana and cocaine use, who was abstinent to all three substances in the month prior to delivery, could have relapsed to cigarettes and marijuana, but not cocaine during the 24-month follow-up period. Thus, she would be included in each relapse risk set separately, in the "relapse" group for the cigarettes and marijuana risk sets, and in the "did not relapse" group for the cocaine risk set. The breakdown of the number of participants in each relapse risk set can be found at the bottom of Table 1.

2.5 Statistical Analysis

The characteristics of participants were summarized and logistic regression analyses were conducted to obtain unadjusted and adjusted odds ratio estimates and 95% confidence intervals of the association between clinical and demographic variables and abstinence status in the last month of pregnancy. The same analytic approach was employed to estimate associations between clinical and demographic variables and relapse status postpartum. Additionally, a similar approach was used to compare demographic variables and type of substance used (i.e. substance use group). For this analysis, each substance use group was used as the primary observation of interest. Covariates used in the logistic regression analysis were age (16 to 21 reference group), race (White reference group), education (less than high school reference group), marital status (married/living with partner reference group), gestational age at intake (4 to 19 weeks reference group), primary drug (alcohol reference group), treatment group (brief advice reference group), and drug or alcohol abuse or dependence. Age was included because older women are more likely to achieve abstinence (Colman and Joyce, 2003).

Kaplan-Meier life tables that indicated participants' time to abstinence to any substance use and time to relapse to any substance use were generated for each of the four substance groups. Multivariate Cox proportional hazards models for multiple events (Therneau and

Gramsch, 2000; Wei et al., 1989) were used to examine whether the risk of abstinence or relapse is related to a particular substance, and to estimate the association between demographic and substance use covariates and abstinence or relapse. Since a subject may be simultaneously in more than one risk set, marginal event modeling for multiple events, with robust sandwich estimate of the covariance matrix was used to account for within-subject correlation (Wei et al., 1989). Covariates included in multivariate Cox models were age, race, education, marital/cohabitating status and treatment group, as these are potential confounding variables (Flynn and Chermack, 2008; Havens et al., 2009; Kennare et al., 2005; Massey et al., 2011; van Gelder et al., 2010). Age was included as a categorical variable, grouped as 16 to 21 (reference group), 22 to 30 and 31 to 44 years; race was categorized as White (reference group), Black, and Hispanic/Other; marital status was coded as married/cohabitating or not married/not cohabitating (reference group); education was coded as less than high school (reference group), high school and post-high school; and treatment group indicated as either brief advice (reference group) or cognitive behavioral therapy. Post hoc linear contrasts were explored to compare differences to abstinence or relapse to specific drug pairs. All statistical analyses were conducted using SAS 9.3.

3. RESULTS

Figure 1 shows the flow of participants from initial screening through the end of the follow-up period. A total of 152 women met baseline substance use criteria and were included in the analysis for abstinence (potential abstinence cohort), and 126 of the 152 women achieved abstinence prior to delivery and were included in the postpartum relapse analysis (potential relapse cohort). There were no significant differences in clinical characteristics between participants in the included in the current analysis (n=152) and participants enrolled in the parent study (n=184). The demographic and clinical characteristics of all participants, the potential abstinence cohort, and the potential relapse cohort are presented in Table 1

The demographic and clinical characteristics of the potential abstinence cohort, are presented according to whether or not women achieved abstinence in pregnancy. Women who were recruited after 28 weeks gestation were less likely to achieve abstinence, compared to women recruited earlier in pregnancy (adjusted OR = 0.19; 95% CI = 0.04-0.94). There were no other demographic or clinical differences between women who did or did not achieve abstinence. The subject characteristics for the potential relapse cohort are presented based on whether or not they relapsed in the postpartum follow-up period. There were no differences in subject characteristics between those who relapsed and those who remained abstinent following delivery. There were no associations between psychiatric diagnosis and abstinence or relapse. Finally, analyses performed to detect differences in demographics and substance use groups found that women in the cocaine group were more likely to be ages 31 to 44 ($p = 0.005$), meet criteria for drug abuse or alcohol dependence ($p = 0.005$), and report dysthymia symptoms ($p = 0.021$), than the participants in the alcohol, marijuana, or cigarettes groups.

3.1 Concurrent Substance Use

Fifty-three women used only one substance (35%), 66 (43%) used two substances, 27 (18%) used three substances and six (4%) used four substances concurrently. Of those using two substances, cigarettes and marijuana was the most common combination, 42% (n=28), followed by alcohol and marijuana, 27% (n=18), cigarettes and cocaine, 15% (n=10), cigarettes and alcohol, 8% (n=5), marijuana and cocaine, 6% (n=4), and alcohol and cocaine, 2% (n=1). For those using three concurrent substances cigarettes, alcohol and marijuana was the most common combination, 74% (n=20), followed by cigarettes, alcohol and cocaine, 22% (n=6), and cigarettes, marijuana and cocaine, 4% (n=1).

3.2 Abstinence

The number of women who met baseline substance use criteria for each of the substances and achieved abstinence is presented in Table 1. The average time to abstinence, mean (SE) days, was 145.81 (9.17), 132.01 (6.17), 151.52 (6.24), and 148.91 (7.68) days for cigarettes, alcohol, marijuana and cocaine, respectively. Shown in Figure 2 are (unadjusted) Kaplan-Meier curves of the time to abstinence for each drug. The majority of women achieved abstinence in the second trimester.

Abstinence among women with concurrent substance used followed a similar pattern. Among women who used two substances concurrently, only 10 out of 43 (23%) women achieved abstinence from cigarettes, compared to 24 out of 24 (100%) women who achieved abstinence from alcohol, 38 out of 50 (76%) women who achieved abstinence from marijuana, and 11 out of 15 (73%) women who achieved abstinence from cocaine. For women who used three concurrent substances, only 10 out of 27 (37%) women achieved abstinence from cigarettes, compared to 25 out of 26 (96%) women who achieved abstinence from alcohol, 16 out of 21 (76%) women who achieved abstinence from marijuana, and five out of seven (71%) women who achieved abstinence from cocaine.

Table 2 displays the results of the multivariate Cox proportional hazards analysis for the factors associated with abstinence in pregnancy. The omnibus test for the abstinence model was significant (Wald statistic=109.714, df=19, $p < 0.0001$). Participants were least likely to achieve abstinence from cigarettes, and were more likely to achieve abstinence from cocaine, marijuana, and alcohol in increasing order. Women were also more likely to attain abstinence from alcohol than marijuana ($p < 0.001$) or cocaine ($p = 0.004$), data not shown. Hispanic women, were more likely to attain abstinence than White non-Hispanic women. Women with a post-high school education, had a greater likelihood of abstinence than women with less than a high school education. Table 2 also illustrates that rates of abstinence differed by concurrent psychiatric illness. There were no other factors significantly associated with abstinence.

3.3 Relapse

The number of women who relapsed during the postpartum follow-up period is shown in Table 1. The average time to relapse, mean (SE) days, was 109.67 (26.34), 127.73 (21.29), 138.35 (25.46), and 287.55 (95.85) days for cigarettes, alcohol, marijuana and cocaine, respectively. Figure 3 shows (unadjusted) Kaplan-Meier curves of the time to relapse to any

use for each drug. By three months postpartum, 58% (n=15) of abstinent smokers relapsed, 51% (n=36) of abstinent women who used alcohol, 41% (n=32) of abstinent women who used marijuana and 27% (n=6) of abstinent women who used cocaine relapsed.

Table 2 also shows the multivariate Cox proportional hazards analysis for the factors associated with relapse postpartum. The omnibus test for the relapse model was significant (Wald statistic = 40.056, df=19, p = 0.0032). When compared to cigarettes, the risk of participants relapsing to cocaine use was significantly lower. Cocaine use was also less likely to recur than alcohol use (p = 0.004), data not shown. While participants appeared to relapse sooner to smoking, these findings did not achieve statistical significance. Women older than 21 years were less likely to relapse than younger women. Women with a diagnosis of major depressive disorder were more likely to relapse than women without a diagnosis of depression. There were no other factors significantly associated with relapse.

4. DISCUSSION

This study examined the onset of abstinence from cigarettes, alcohol, marijuana and cocaine in pregnancy and the pattern of relapse to these substances following delivery. To the knowledge of the authors, this is the first study to prospectively examine pregnancy-related abstinence and postpartum relapse into substance use. This was explored in a carefully characterized cohort of women followed for two years after delivery. Pregnancy-related abstinence rates were high among participants who used alcohol, marijuana and cocaine, but not smokers. Only 32% of the group who were smokers achieved abstinence. Postpartum relapse was common to all substances although the rate of relapse to cocaine was lower (41%) than relapse rates for other substances by two years post-delivery. While women showed a positive trend toward earlier relapse to cigarettes, with 27% relapsing in the first month following delivery and 58% relapsing by 3-months postpartum, this was not significantly different than relapse to alcohol or marijuana.

Other reports that have not included short interval prospective follow-up also find pregnant women are more likely to discontinue alcohol and illicit substances and least likely to discontinue cigarette use (Ebrahim and Gfroerer, 2003; Massey et al., 2011; Passey et al., 2014). The high rates of relapse following delivery in this study are consistent with the smoking literature (Gyllstrom et al., 2012; Park et al., 2009; Tran et al., 2013; Yasuda et al., 2013) and the limited literature on postpartum relapse to alcohol and illicit substances (Ebrahim and Gfroerer, 2003; Gilchrist et al., 1996; Howell et al., 1999). However, the longitudinal nature of this study is unique and allows us to estimate the reduction of substance use over the course of pregnancy and the pattern of relapse in the first two years following delivery. Furthermore, this study had biological confirmation of both abstinence and relapse, which few other studies had.

This detailed evaluation of substance use in perinatal women suggests differences in the risk of abstinence and relapse between substances in the setting of a high degree of concurrent substance use. One potential explanation for the lower rates of smoking abstinence is that women might be substituting smoking for alcohol, marijuana or cocaine use. Women may perceive illicit substances and alcohol as more harmful and less socially acceptable than

cigarettes, and thus decide to give up use of the other substances but not cigarettes (Moore et al., 2010). This is supported by the low smoking abstinence rates in women with concurrent substance use. Another interesting finding from the analysis is the lower rate of relapse to cocaine compared to other substances. This may seem contrary to the common notion of cocaine's “addictiveness” or greater abuse potential. It is unclear if this difference reflects a higher baseline threshold for relapse or a greater commitment to stay clean. There may also be extrinsic factors, such as the involvement of child protective services, which might contribute to the lower rate of relapse (Davis and Yonkers, 2012).

The implications of these findings are substantial. First, the findings support the screening of all pregnant women for substance use that occurred prior to conception. Women with a history of substance use are at high risk of relapse, will need to be monitored, and may require referral to treatment. Second, continued cigarette use can be used as an indicator of possible other drug use, given 77% of women with concurrent substance use were smokers and only 29% of them achieved abstinence. This is in line with previous findings that smoking status is a predictor of illicit substance use in pregnancy (Goel et al., 2011; Hutchins and Dipietro, 1997; Yonkers et al., 2010). In addition, clinicians often put greater treatment resources in helping women attain and maintain abstinence to illicit substances while smokers had overall lower quit rates and higher relapse rates. Third, the findings support the need for ongoing treatment after delivery, particularly in the first 3-months postpartum when most women relapse. Lastly, research into novel interventions is needed to enhance pregnancy-related abstinence and prevent postpartum relapse. While this is true for all substances, it is most relevant for smoking given the low rates of abstinence, high rates of relapse and significant negative health impact on the mother, the developing fetus and growing infant (Cnattingius, 2004). This also highlights the need for interventions that can identify the motivational factors that support positive behavior change and capitalize on the intrinsic and extrinsic factors that might be contributing to pregnancy-related discontinuation. Overall, these results demonstrate how pregnancy and the postpartum period are opportunities for intervention and “teachable” moments that can motivate women to adopt risk-reducing health behaviors (McBride et al., 2003).

The results of the current analysis need to be considered in the light of its limitations. This is a secondary analysis not designed to specifically evaluate differences in abstinence and relapse by drug. The size of the analytical sample allows us power to detect only large differences between groups. In addition, since the analytic cohort was drawn from a randomized controlled trial for a behavioral treatment for substance use in pregnancy, treatment group designation could have differentially affected abstinence or relapse. However, there were no differences between treatment groups in the original trial (Yonkers et al., 2012), and we did not see any difference in abstinence or relapse when we controlled for treatment group in the current analysis. Information on whether women intended to abstain from substance use permanently or just temporarily suspend use during pregnancy was not available. Thus, it is possible that the relapse rates might be biased by women who never intended to stop use all together. In addition, women who were receiving treatment for substance use were excluded, including those undergoing opiate agonist treatment at the inception of the study, thus the sample may have been biased toward women who had less severe substance use. Finally, the generalization of the results to the pregnant population at

large may be limited by the fact that the sample was derived from inner city hospital clinics, even though the pool of potential participants was large (n=2661) and diverse.

This longitudinal study of perinatal women with a history of substance use found that pregnancy-related abstinence rates were high among women with alcohol, marijuana and cocaine user, but not smokers. Postpartum relapse was common for all substances, with the relapse rate for cocaine being lower than those of the other substances. These findings suggest differences in the risk of abstinence and relapse between substances used by perinatal women, and point to pregnancy and the postpartum period as opportunities for intervention that can lead to long term abstinence.

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Highlights

- We examined the course of substance use in perinatal women.
- 83% of women achieved abstinence in pregnancy.
- 80% of women relapsed in the 2 years after delivery.
- Abstinence was more likely for alcohol, marijuana and cocaine than cigarettes.

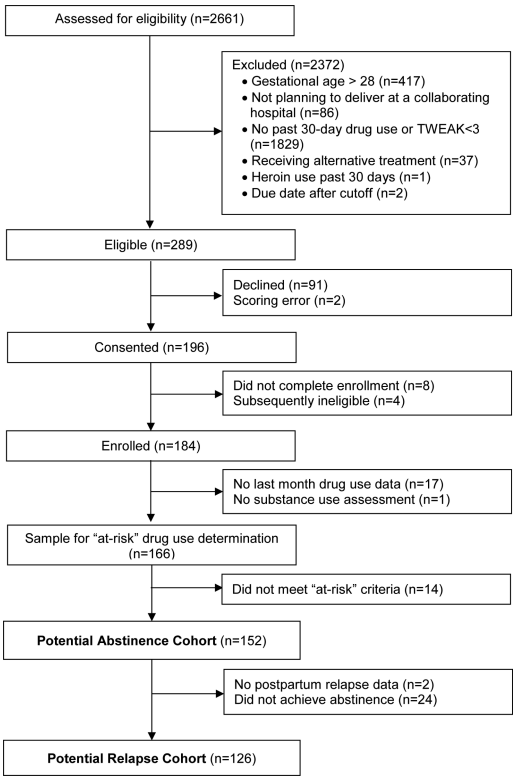

Figure 1. Flow of Study Participants

Of the 2661 women screened, 289 were eligible, and 91 (32%) declined to participate. Of the 196 women consented, 184 completed enrollment, and 166 had sufficient data collected to determine baseline substance use according to the predefined use levels. From these 166 women, 152 met baseline substance use criteria and were included in the analysis for abstinence (potential abstinence cohort), and 126 of the 152 women achieved abstinence prior to delivery and were included in the postpartum relapse analysis (potential relapse cohort).

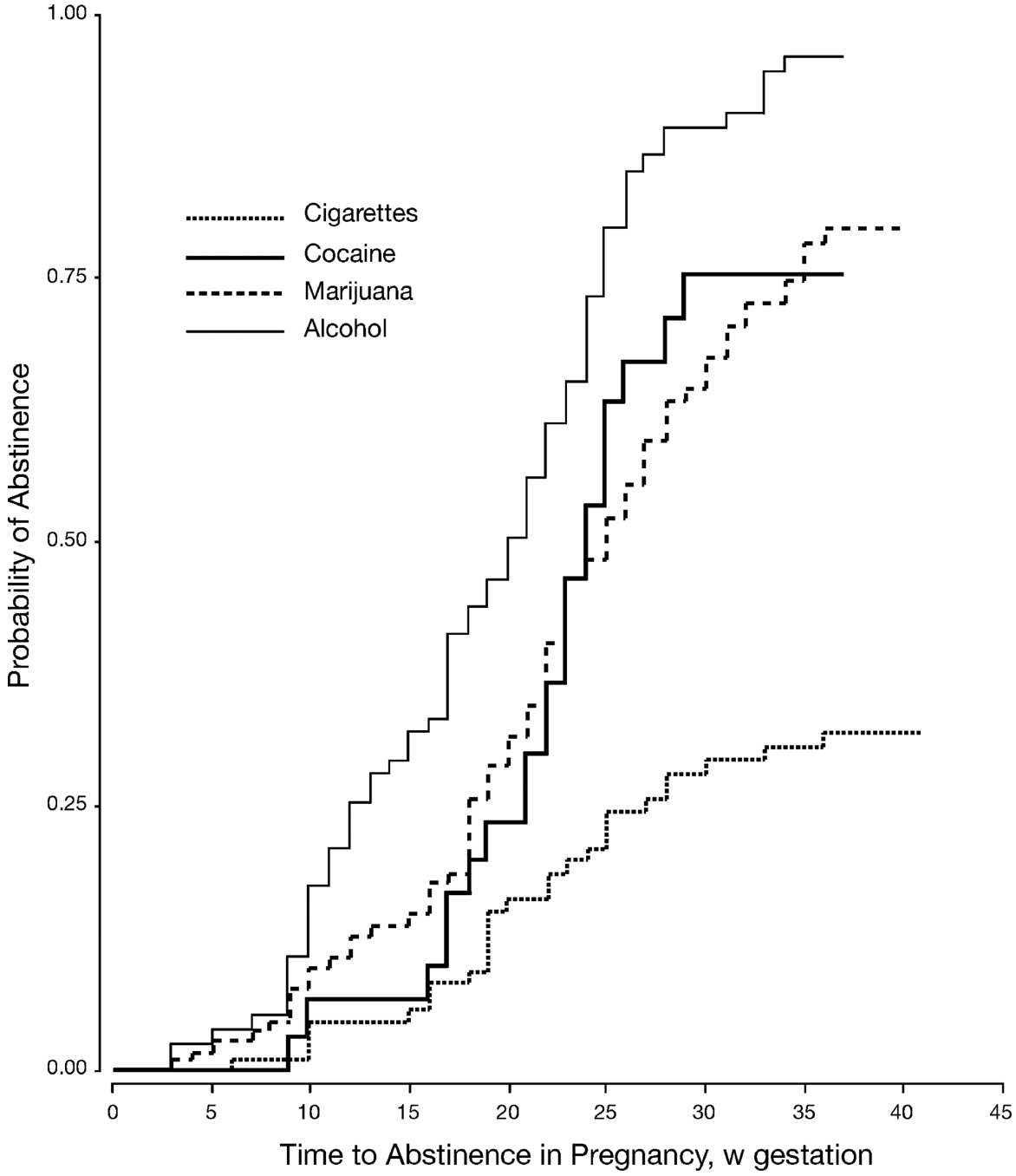

Figure 2. Time to Abstinence in Pregnancy by Drug

Kaplan-Meier estimates of the time interval in pregnancy (weeks in pregnancy) to abstinence from cigarettes, alcohol, marijuana or cocaine.

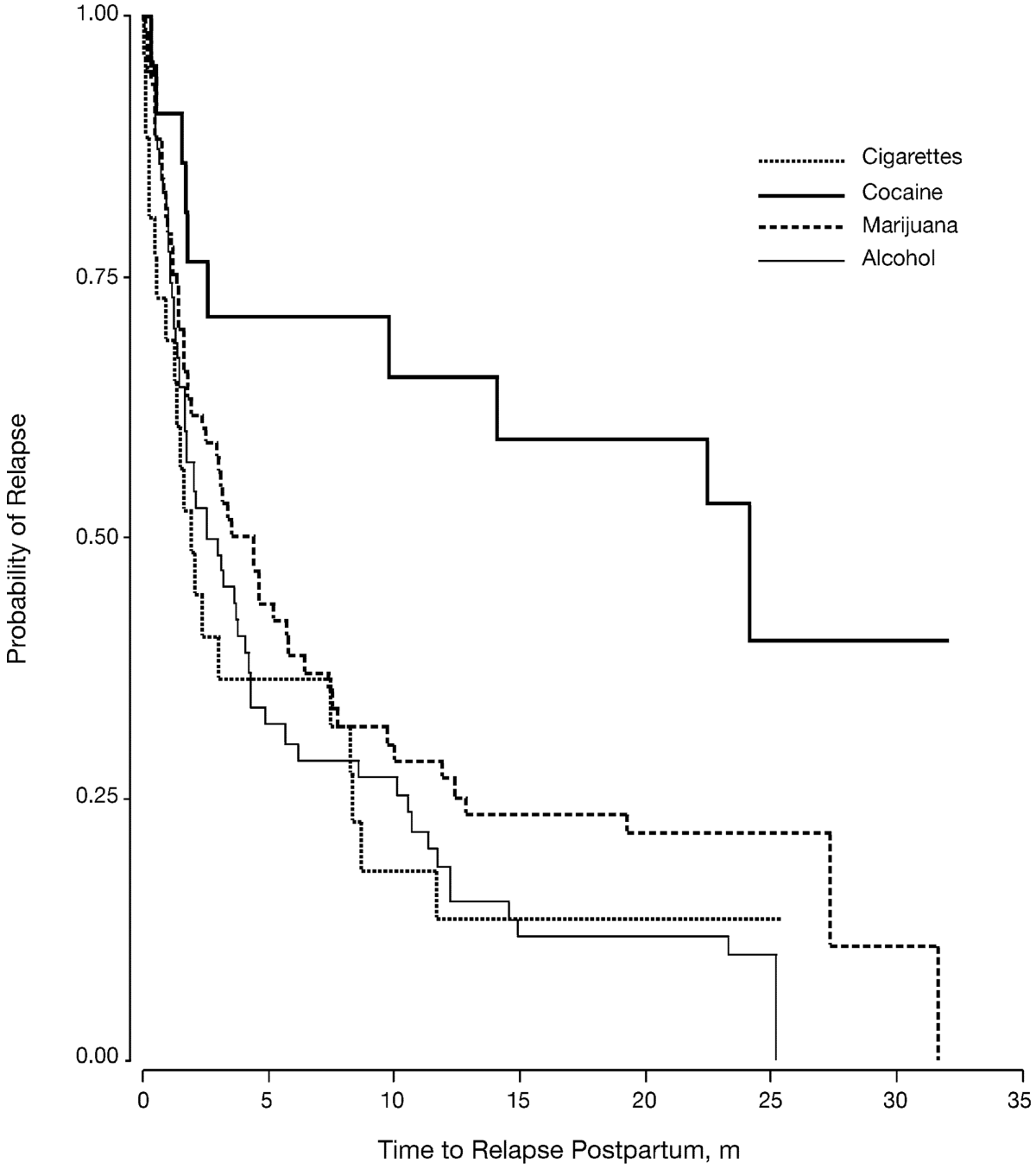

Figure 3. Time to Relapse After Delivery by Drug

Kaplan-Meier estimates of the time from delivery until relapse to cigarettes, alcohol, marijuana or cocaine in the 24 months postpartum.

Table 1

Baseline Characteristics of the Full Study Sample, the Potential Abstinence Cohort and the Potential Relapse Cohort, and Baseline Use, Abstinence and Relapse by Substance Group

		Potential Abstinence Cohort (N=152)[a]		Potential Relapse Cohort (N=126)[a]	
	All subjects (N = 152)[a]	Achieved Abstinence (N=126)	Did Not Achieve Abstinence (N=26)	Relapsed (N=101)	Did Not Relapse (N=25)
Characteristic	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**
Age, years					
16 to 21	34 (25)	30 (26)	4 (18)	24 (26)	6 (24)
22 to 30	75 (54)	63 (54)	12 (55)	50 (55)	13 (52)
31 to 44	29 (21)	23 (20)	6 (27)	17 (19)	6 (24)
Race/Ethnicity					
White	34 (22)	30 (24)	4 (15)	22 (22)	8 (32)
Black	82 (54)	63 (50)	19 (73)	53 (53)	10 (40)
Hispanic/Other	36 (24)	33 (26)	3 (12)	26 (26)	7 (28)
Education					
Less Than High School	52 (34)	44 (35)	8 (31)	34 (34)	10 (40)
High School	57 (38)	46 (37)	11 (42)	37 (36)	9 (36)
Post-High School	43 (28)	36 (28)	7 (27)	30 (30)	6 (24)
Marital Status					
Married/Living with Partner	53 (35)	44 (35)	9 (35)	35 (35)	9 (36)
Not Married or Cohabitating	99 (65)	82 (65)	17 (65)	66 (65)	16 (64)
Gestational age at intake, weeks					
4-19	69 (46)	61 (49)	8 (31)	50 (51)	11 (44)
20-28	65 (43)	52 (42)	13 (50)	39 (39)	13 (52)
29-34	16 (11)	11 (9)[b]	5 (19)	10 (10)	1 (4)
Treatment Group					
Brief Advice	79 (52)	63 (50)	16 (62)	50 (49)	13 (52)
Cognitive Behavioral Therapy	73 (48)	63 (50)	10 (38)	51 (51)	12 (48)
Drug or Alcohol Abuse or Dependence	50 (33)	39 (31)	11 (42)	29 (29)	10 (40)
Psychiatric Diagnosis					
Major Depressive Disorder	33 (22)	28 (23)	5 (19)	25 (25)	3 (12)
Dysthymia	9 (6)	9 (7)	0 (0)	6 (6)	3 (12)
Panic Disorder	10 (7)	8 (7)	2 (8)	7 (7)	1 (4)
Agoraphobia	21 (14)	16 (13)	5 (19)	11 (11)	5 (20)
Social Phobia	7 (5)	6 (5)	1 (4)	5 (5)	1 (4)
Obsessive Compulsive Disorder	3 (2)	3 (2)	0 (0)	2 (2)	1 (4)
Generalized Anxiety Disorder	18 (12)	17 (14)	1 (4)	13 (13)	4 (16)
Posttraumatic Stress Disorder	19 (13)	16 (13)	3 (12)	13 (13)	3 (12)

Substance Use Group[c]	Baseline Use by Substance Group	Abstinence By Substance Group[d]		Relapse By Substance Group[d]	
		Achieved Abstinence	Did not Achieve Abstinence	Relapsed	Did Not Relapse
Cigarettes	84 (55)	27 (32)	57 (68)	24 (89)	3 (11)
Alcohol	75 (49)	72 (96)	3 (4)	59 (82)	13 (18)
Marijuana	101 (66)	79 (78)	22 (22)	55 (70)	24 (30)
Cocaine	30 (20)	22 (73)	8 (27)	9 (41)	13 (59)

[a] Frequencies and column percentages reported. Numbers may not sum to total due to missing data.

[b] Women who achieved abstinence were less likely to be recruited late in pregnancy, p = 0.042. There were no other differences between groups in baseline characteristics.

[c] Group membership was determined by women who met the following baseline criteria of use: five or more cigarettes per day for cigarettes; seven drinks per week or three or more per day for alcohol; any marijuana use; or any cocaine use.

[d] Frequencies and row percentages for each cohort are reported. Participants could use more than once substance, thus the total could be greater than the sample size (n=152).

Table 2

Factors Associated with Abstinence in Pregnancy and Relapse Postpartum[a]

	Hazard Ratio (95% Confidence Interval)			
Factor	**Abstinence**	***P* Value**	**Relapse**	**P Value**
Drug				
Cigarettes	Reference		Reference	
Alcohol	7.31 (4.34-12.32)	< 0.001	1.09 (0.62-1.90)	0.767
Marijuana	4.43 (2.66-7.37)	< 0.001	0.71 (0.40-1.23)	0.220
Cocaine	3.67 (2.02-6.68)	< 0.001	0.38 (0.16-0.92)	0.032
Age, years				
16 to 21	Reference		Reference	
22 to 30	0.93 (0.63-1.36)	0.696	0.57 (0.35-0.92)	0.021
31 to 44	0.80 (0.51-1.26)	0.336	0.37 (0.19-0.71)	0.003
Race				
White	Reference		Reference	
Black	0.73 (0.52-1.03)	0.067	1.42 (0.87-2.32)	0.162
Hispanic or Other	1.89 (1.23-2.90)	0.003	1.04 (0.58-1.86)	0.901
Education				
Less than High School	Reference		Reference	
High School	1.22 (0.83-1.80)	0.315	1.43 (0.89-2.30)	0.141
More than High School	2.05 (1.37-3.07)	0.001	1.50 (0.85-2.65)	0.157
Relationship				
Married/cohabitating	Reference		Reference	
Not married/not cohabitating	1.41 (1.02-1.96)	0.038	1.04 (0.69-1.56)	0.851
Treatment Group				
BA	Reference		Reference	
CBT	1.20 (0.87-1.65)	0.273	1.04 (0.68-1.60)	0.847
Psychiatric Diagnosis[b]				
Major Depressive Disorder	0.97 (0.62-1.53)	0.890	2.46 (1.40-4.31)	0.002
Dysthymia	1.60 (0.95-2.68)	0.077	0.85 (0.38-1.92)	0.696
Panic Disorder	0.74 (0.36-1.54)	0.425	1.05 (0.35-3.20)	0.926
Agoraphobia	1.43 (0.86-2.37)	0.167	0.84 (0.40-1.79)	0.654
Social Phobia	0.76 (0.34-1.71)	0.508	1.36 (0.37-5.02)	0.647
Obsessive Compulsive Disorder	2.24 (1.18-4.25)	0.013	0.37 (0.10-1.31)	0.123
Generalized Anxiety Disorder	2.09 (1.22-3.58)	0.008	0.82 (0.39-1.71)	0.594
Posttraumatic Stress Disorder	0.47 (0.22-0.96)	0.039	0.71 (0.31-1.65)	0.430

[a] Using multivariate Cox proportional hazards models for multiple events.

[b] The reference group for each psychiatric diagnosis was women without the diagnosis.