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Are pregnancy planning and pregnancy timing associated with maternal psychiatric illness, psychological distress and support during pregnancy?

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Abstract

Background—Pregnancy planning and timing may be associated with psychiatric illness, psychological distress and support during pregnancy.

Methods—We performed secondary analyses of a prospective cohort of 2,654 pregnant women evaluating the impact of depression on preterm birth. We used multivariable logistic regression to test associations between pregnancy planning ("Was this pregnancy planned? Yes/No") and/or timing ("Do you think this is a good time for you to be pregnant?") with Composite International Diagnostic Interview generated psychiatric diagnoses and measures of psychological distress and support.

Results—37% and 13% of participants reported an unplanned or poorly timed pregnancy, respectively. Unplanned pregnancies were associated with a Major Depressive Episode (MDE) (adjusted odds ratio (aOR) 1.69, 95%CI 1.23–2.32) and the Cohen Perceived Stress Scale's (CPSS) highest quartile (aOR 1.74, 95%CI 1.40–2.16). Poorly timed pregnancies were associated with a MDE (aOR 3.47, 95%CI 2.46–4.91) and the CPSS's highest quartile (aOR 5.20, 95%CI 3.93–6.87). Poorly timed pregnancies were also associated with General Anxiety Disorder (GAD; aOR 1.60, 95%CI 1.07–2.40), and the modified Kendler Social Support Inventory's (MKSSI)

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Conflicts of Interest

Dr. Gariepy reports no competing interests. Dr. Lundsberg reports no competing interests. Dr. Miller reports no competing interests. Dr. Stanwood reports no competing interests. Dr. Yonkers reports no competing interests.

lowest quartile (aOR 1.64, 95%CI 1.25–2.16). Psychiatric conditions were strongly associated with planned pregnancies that were subsequently deemed poorly timed (MDE=aOR 5.08, 95%CI 2.52–10.25; GAD=aOR 2.28, 95%CI 1.04–5.03); high CPSS=aOR 6.48, 95%CI 3.59–11.69; and low MKSSI=aOR 3.19, 95%CI 1.81–5.62).

Limitations—Participant characteristics may limit generalizability of findings.

Conclusions—Pregnancy timing was a stronger predictor of maternal psychiatric illness, psychological distress and low social support than pregnancy planning in our cohort.

Keywords

unplanned pregnancy; psychological distress; depression; anxiety; social support

INTRODUCTION

More than half (51%) of all pregnancies in the United States are unplanned (Finer and Zolna, 2014), which includes pregnancies that are unintended, mistimed, or unwanted (Finer and Zolna, 2014; Santelli et al., 2009). The multi-dimensionality of pregnancy planning and timing also encompasses the seemingly disparate circumstances of unplanned pregnancies that occur at a good time and planned pregnancies that are subsequently assessed to be poorly timed (Santelli et al., 2009). For example, whether a pregnancy was planned 3 months ago does not necessarily reflect the evolving circumstances of relationships, employment, or housing.

Unplanned pregnancies resulting in live births (37% of all births) (Finer and Zolna, 2014; Santelli et al., 2009) are associated with poor maternal and neonatal outcomes including delayed prenatal care, increased physical violence, low birth weight, reduced breastfeeding, decreased inter–pregnancy intervals, and increased risk of lower educational attainment and behavioral issues for children from unplanned pregnancies (Brown and Eisenberg, 1995; Cheng et al., 2009; Cleland et al., 2011; Logan et al., 2007). Whether unplanned pregnancy is associated with maternal psychiatric illness or psychological distress and low social support is not clear.

During pregnancy, approximately 8.3% to 12.7% of U.S. women experience a major depressive episode (MDE), and 16.7% to 24.6% experience depressive symptoms (Bennett et al., 2004; Gaynes et al., 2005; Grote et al., 2010). Maternal depression during pregnancy is associated with poor maternal and neonatal outcomes; Dayan et al., 2006; Gipson et al., 2008; Grigoriadis et al., 2013; Grote et al., 2010; Khashan et al., 2014; Orr et al., 2002); however, data are inconclusive (Yonkers et al., 2011). Some U.S. studies find an association between unplanned pregnancy and depressive symptoms during the pregnancy (Barber et al., 1999; Fellenzer and Cibula, 2014; Messer et al., 2005; Orr and Miller, 1997) while others do not (Lancaster et al., 2010; Maximova and Quesnel-Vallée, 2009; Maxson and Miranda, 2011; Phipps and Nunes, 2012). However, these studies were limited by lack of adjustment for confounding by race (Barber et al., 1999), parity (Barber et al., 1999; Fellenzer and Cibula, 2014; Messer et al., 2005; Orr and Miller, 1997), history of mental health disorders (Barber et al., 1999; Fellenzer and Cibula, 2014; Messer et al., 2005; Orr and Miller, 1997),

use of tobacco or illicit substances (Messer et al., 2005; Orr and Miller, 1997), and by using non-validated measures of depression (Fellenzer and Cibula, 2014; Phipps and Nunes, 2012), and retrospective assessments of pregnancy intention and depressive symptoms (Barber et al., 1999; Fellenzer and Cibula, 2014) which may be subject to recall and reporting bias (Santelli et al., 2009). If unplanned or poorly timed pregnancy is associated with depression, antenatal screening for unplanned pregnancy could identify pregnant women at increased risk of depressive symptoms that may be amenable to treatment interventions.

Approximately 8.5% of women experience General Anxiety Disorder (GAD) during pregnancy, (Ross and McLean, 2006) which may elevate the risk for poor neonatal outcomes (Dunkel Schetter and Tanner, 2012; Kramer et al., 2009). Previous studies have not found an association between unplanned pregnancy and anxiety (Sayil et al., 2006; Tenkku et al., 2009), but are limited by retrospective (postpartum) assessment of pregnancy planning (Sayil et al., 2006) or inconsistent assessment of pregnancy planning (Tenkku et al., 2009) that can bias results (Santelli et al., 2009).

Perceived psychological stress during pregnancy, referring to the degree that life events are uncontrollable or unpredictable, is linked with depression and panic disorder (Maxson and Miranda, 2011; Woods et al., 2010). Furthermore, perceived stress during pregnancy is associated with adverse birth outcomes (Dunkel Schetter, 2011). While previous studies demonstrate a significant association between unplanned pregnancy and perceived stress (Maxson and Miranda, 2011; Messer et al., 2005; Orr and Miller, 1997), most studies did not address potential confounding factors (Messer et al., 2005; Orr and Miller, 1997).

Positive social support is one of the most effective methods for coping with stress and is associated with decreased depression and anxiety, decreased time to recovery from illness, and even reduction in mortality (Kim et al., 2008). In pregnancy, women with higher levels of social support demonstrate better mental health outcomes (Balaji et al., 2007). Lack of social support, is associated with giving birth to a small for gestational age infant (Dunkel Schetter, 2011). Some researchers find that unplanned pregnancy is associated with lower levels of social support (Orr and Miller, 1997; Sable et al., 2007). Again, the literature is inconsistent (Maxson and Miranda, 2011), and limited by lack of adjustment for confounding (Orr and Miller, 1997; Sable et al., 2007), small sample size (Sable et al., 2007), and use of non-validated measurement tools for social support (Orr and Miller, 1997).

We investigated the association between unplanned or poorly timed pregnancy and maternal symptoms of depression, anxiety, perceived stress and social support. We hypothesized that women with unplanned or poorly timed pregnancies would have greater psychiatric morbidity (MDE, GAD), greater perceived stress, and lower reported social support than those with planned and well-timed pregnancies.

METHODS

Recruitment, Enrollment, and Assessment Procedures

We performed a secondary analysis of a prospective cohort study designed to explore the associations of major depressive episodes or antidepressant medication use in pregnancy with adverse birth outcomes, including the risk for preterm birth (Yonkers et al., 2011; Yonkers et al., 2012). Secondary analyses were pre-planned and funded by the Yale Center for Clinical Investigation. Women were eligible for the parent study if they were at least 18 years of age or more (16 years at the Yale site), less than 18 weeks estimated gestational age with a singleton pregnancy, spoke English or Spanish, and had access to a telephone. All potentially eligible women with a history of antidepressant use or a major depressive episode in the last 5 years were invited to participate. For the comparison group, one-third of potentially eligible women without these characteristics were randomly selected and invited to participate in the study. Women were deemed ineligible if they had insulin-dependent diabetes which was an independent risk factor for preterm birth, plans to terminate their pregnancy since only women with continuing pregnancies could be at risk of preterm birth, or intention to relocate. The original study size was calculated to show a 2-fold difference in preterm birth among women exposed to depression or antidepressant medication, compared to those who were not exposed, with 85% power assuming a 5% preterm birth rate (Yonkers et al., 2012). Yale University School of Medicine and participating hospitals provided human subjects approval for the study.

Study staff recruited and enrolled pregnant women receiving prenatal care from 137 obstetrical practices and hospital-based clinics in Connecticut and Western Massachusetts between March 2005 and May 2009. Study follow-up continued until September 2009. Staff obtained verbal consent from participants and administered a screening questionnaire to collect information on gestational age, current mood, lifetime and current mood and anxiety disorders, antidepressant treatment, and exclusion criteria.

Selected participants provided written consent for study interviews and medical record review, and completed an initial home interview before 18 weeks estimated gestational age (EGA). Staff interviewed participants again by phone at 28 (± 2) weeks gestation and 8 (± 4) weeks after delivery. All staff interviewers received extensive training including at least 4 days of instruction and 4 supervised interviews.

Exposure and Outcome Measures

At the initial interview, interviewers obtained data on demographic and potential confounding variables, including mental health outcomes. Maternal age, race, ethnicity, education, marital status, parity, pregnancy history including previous preterm birth, tobacco use, alcohol use, other illicit drug use, and medication use was collected. The Edinburgh Postnatal Depression Scale (EPDS), the Cohen Perceived Stress Scale (CPSS), and the modified Kendler Social Support Interview (MKSSI) were administered at the first visit (Cohen and Williamson, 1988; Cox and Holden, 1994; Spoozak et al., 2009). The CPSS evaluates the degree to which individuals feel that life events are unpredictable and uncontrollable (Cohen and Williamson, 1988). The MKSSI is a reliable and valid tool for

assessing social support (emotional and instrumental support) in pregnant women (Spoozak et al., 2009).

At each of the three interviews, participants answered questions about major depressive disorder, generalized anxiety disorder, and panic disorder from the World Mental Health Composite International Diagnostic Interview v2.1 (WMH-CIDI) (WHO, 1997). The WMH-CIDI is a valid and reliable lay interview instrument whether administered in person or over the telephone, is accepted for use in pregnant women, and is further described in previous publications regarding this study (Yonkers et al., 2011; Yonkers et al., 2012). Perceived stress, and social support were not assessed at the second or third visit.

We measured the exposure of interest at the first study visit (before 18 weeks EGA). Interviewers assessed pregnancy intention by asking women whether their pregnancy was planned ("Was this pregnancy planned? Yes/No"), and whether they thought it was a good time for them to be pregnant ("Do you think this is a good time for you to be pregnant? Yes/No").

We used standard of care definitions and validated tools for outcome measurements. A standard algorithm for the WMH-CIDI was used to determine whether a participant likely met criteria for a MDE or GAD during pregnancy. A score of greater than or equal to 20 on the CPSS represented the highest quartile and defined highest perceived stress during pregnancy. A score of 3.2 or less on the MKSSI represented the lowest quartile and defined lowest social support during pregnancy. Gestational age was verified by a first-trimester ultrasound where available, last menstrual period, due date set by a physician, or earliest prenatal ultrasound.

Statistical Analysis

We used multivariable logistic regression to estimate the association of pregnancy planning and timing with depression, anxiety, perceived stress and social support, and calculated unadjusted and adjusted odds ratios, controlling for potential confounding variables. We identified possible demographic factors (chosen *a priori*) that might confound the relationship between pregnancy planning or timing and maternal psychological distress and social support outcomes. Mother's age, education, race, marital status, history of sexual abuse prior to age 18, use of tobacco, alcohol or illicit drugs, depression (major depression 6 months before pregnancy and/or during pregnancy), panic disorder, benzodiazepine use during pregnancy, and stress are all correlates of pregnancy planning/timing, and/or maternal psychological distress, and/or social support (Bayrampour et al., 2015; Brown and Eisenberg, 1995; Cheng et al., 2009; Fellenzer and Cibula, 2014; Finer and Zolna, 2014; Hall et al., 2014; Nunes and Phipps, 2013; Yonkers et al., 2014). To estimate the risk of MDE, GAD, high perceived stress, and low social support, we generated separate logistic regression models for pregnancy planning and timing. In addition to the binary exposures of planning and timing, we created a 4-level exposure variable: (1) women with an unplanned pregnancy occurring at a bad time, (2) women with an unplanned pregnancy occurring at a good time, (3) women with a planned pregnancy occurring at a bad time, and (4) women with a planned pregnancy occurring at a good time (reference category). Final multivariable models were developed using backwards selection at α=0.10 significance level. We also

tested the interaction term for panic disorder and history of sexual abuse prior to age 18 in each multivariable model. Statistical analyses were performed using SAS 9.4 (SAS Institute, Cary, NC).

RESULTS

Our cohort included 2654 women with singleton, live births who completed the initial interview assessing exposures of pregnancy planning and timing status, after excluding women with multiple births, miscarriage, stillbirth, abortion, and withdrawals. Data on psychological distress and social support outcomes were available for more than 99% of participants. Of these 2654 women, 2487 (94%) completed at least 1 of the 2 remaining interviews (at 28 weeks EGA or 8 weeks postpartum) (Yonkers et al., 2012).

Table 1 presents demographic and other characteristics for all participants across maternal psychological distress and support outcomes. Our study population was primarily white (73.7%), educated (56.6% of women reported 16 or more years of education), married or living with a partner (87%), and older (mean age 31, 83.5% age 25 or older). Overall, 37% of participants reported unplanned pregnancies and 13% reported that it was not a good time to be pregnant (Table 1). Information on pregnancy planning was missing for 3 participants and information on pregnancy timing was missing for 23 participants. Approximately 8% of participants were in episode for MDE, 9% GAD, 28% scored in the highest quartile for perceived stress, and 23% scored in the lowest quartile for social support. Information on perceived stress was missing for 15 participants.

Results of multivariate unadjusted models are presented in Table 2 and results of multivariate adjusted models are presented in Table 3. In multivariate adjusted models, unplanned pregnancies were significantly associated with MDE (aOR 1.69, 95% CI 1.23–2.32) and were more likely to score in the highest quartile of the CPSS (aOR 1.74, 95% CI 1.40–2.16).

In multivariate adjusted models, pregnancies occurring at a bad time were associated with MDE (aOR 3.47, 95% CI 2.46–4.91) and GAD (aOR 1.60, 95% CI 1.07–2.40), and were more likely to score in the highest quartile of the CPSS (aOR 5.20, 95% CI 3.93–6.87) and the lowest quartile of the MKSSI (aOR 1.64, 95% CI 1.25–2.16).

In multivariate adjusted models examining pregnancy planning and timing as a 4-level exposure variable, the largest estimates were observed among women reporting planned pregnancies not occurring at a good time, which was significantly associated with MDE (aOR 5.08, 95% CI 2.52–10.25), GAD (aOR 2.28, 95% CI 1.04–5.03), the highest quartile of the CPSS (aOR 6.48, 95% CI 3.59–11.69), and the lowest quartile of the MKSSI (aOR 3.19, 95% CI 1.81–5.62), compared to those with planned, well-timed pregnancies. Pregnancies that were unplanned and poorly timed were significantly associated with MDE (aOR 3.70, 95% CI 2.46–5.58), GAD (aOR 1.73, 95% CI 1.06–2.81), and the highest quartile of the CPSS (aOR 6.03, 95% CI 4.35–8.38), but not significantly associated the lowest quartile of the MKSSI (aOR 1.24, 95% CI 0.89–1.75). Pregnancies that were

unplanned and well-timed were only associated with the highest quartile of the CPSS (aOR 1.41, 95% CI 1.11–1.80).

DISCUSSION

In this secondary analysis of a prospective cohort study, we found that pregnancy planning and pregnancy timing were significantly associated with maternal psychiatric morbidity, psychological distress and poor social support outcomes during pregnancy. Compared to women with unplanned pregnancies, women who reported poorly timed pregnancies showed significant associations with all four maternal mental health outcomes (MDE, GAD, stress, and social support). Pregnancy timing was a better predictor of poor maternal psychological distress and support outcomes than pregnancy planning in our cohort. In fact, the largest effect size for associations with psychiatric morbidity in our 4-level multivariate models were observed among women with pregnancies that were planned but poorly timed, followed by pregnancies that were unplanned and poorly timed. However, we note that confidence intervals for these two groups overlap for some outcomes (MDE, GAD, and perceived stress) and we cannot say for certain that they differ from each other.

To the best of our knowledge, this analysis of the relationship between pregnancy planning and timing with psychosocial distress and support is the largest published prospective cohort of pregnant women with individual assessments reported. Our study was robust in its adjustment for multiple potential confounders, including maternal demographics, medical conditions, and other risk factors, which improves upon previous analyses that did not account for these potential contributing factors (Messer et al., 2005; Orr and Miller, 1997; Phipps and Nunez, 2012; Sable et al., 2007). An additional strength is the systematic collection of psychological outcome data on dimensional measures of distress (eg. Cohen PSS, Edinburgh Postnatal Depression Scale) and syndromal diagnoses for a MDE or GAD using multiple validated measures of both symptoms and diagnostic criteria. Another strength of our study is its use of two questions about pregnancy intention (one direct question about whether the pregnancy was planned and a second question about whether the timing of pregnancy was good) that were asked during the first interview, before 18 weeks' EGA, before birth outcomes. Importantly, this early assessment decreases the risk of recall and social desirability biases.

Characteristics of study participants may limit the generalizability of our findings. Our cohort was primarily 25–34 years old, white and non-Hispanic, highly educated, married or living with a partner, and therefore our findings may not be applicable to other populations of pregnant women. Furthermore, potential participants who chose to terminate their pregnancy were excluded from this study as the main outcome was preterm birth. Since women with unplanned, undesired pregnancies are more likely to choose pregnancy termination, it is not surprising that our cohort would have a relatively high population of planned pregnancies, occurring at a good time in women's lives. Despite this, participants in this cohort exhibited a similar rate of unplanned pregnancy compared to national statistics (37% in ours and 40% nationally (Finer and Zolna, 2014)), and similar prevalence of depression and anxiety compared to national statistics (Bennett et al., 2004; Gaynes et al., 2005; Grote et al., 2010). Nevertheless, our findings may not be applicable to women with

unplanned and/or poorly timed pregnancies that choose pregnancy termination. We also did not collect information on family history of psychiatric illness, which could potentially confound our results.

We cannot comment on causality with this analysis. It may be that an unplanned or poorly timed pregnancy contributed to the onset of an MDE or to GAD, or the existence of these illnesses may have contributed to an assessment of the pregnancy as unplanned or poorly timed. The endorsement of poor timing showed a particularly strong association with an MDE. Furthermore, our study supports the importance of multi-dimensional assessments of pregnancy planning and timing (Santelli et al., 2009) and strengthens our understanding of the association between maternal psychiatric morbidity, psychological distress and poor social support with poorly timed pregnancies, especially among those that are initially planned. Some women may plan a pregnancy and then have a serious life event (e.g. illness, relationship disruption) that leads them to characterize the pregnancy as poorly timed and may be contributing to the mental illness episodes.

Our findings have important implications for future research and for women's pregnancy care. Future studies that include assessment of pregnancy planning and timing, MDE, GAD, perceived stress, and social support before, during, and after pregnancy would contribute to further understanding of causality. During pregnancy care, screening for pregnancy timing and planning among newly pregnant women may help identify women at increased risk for depression, anxiety, high perceived stress and low social support, and contribute to more effective pregnancy options counseling. If identified, women may benefit from targeted interventions that can decrease their psychiatric burden and risk of poor maternal mental health outcomes.

Our study adds to a body of research aimed at understanding the effects of pregnancy planning and timing on women's mental health. Among our cohort, unplanned and/or poorly timed pregnancies were associated with psychiatric illness or psychological distress and poor social support. Our findings reinforce the recent recommendation from the American College of Obstetricians and Gynecologists (American College of Obstetricians and Gynecologists, 2015) and from the United States Preventive Services Task Force (O'Connor et al., 2016) to screen and provide appropriate treatment for depression and anxiety at least once during the perinatal period for all pregnant women, and to screen more often for women with risk factors such as unplanned and/or poorly timed pregnancies.

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HIGHLIGHTS

- Unclear if unplanned/poorly timed pregnancies associated with psychological distress
- Prior analyses limited by methodological limitations; no adjustment for confounding
- Current study: Individual assessments in large prospective cohort of pregnant women
- Key Findings:
  - Unplanned and poorly timed pregnancies significantly associated with MDE & high stress
  - Poorly timed pregnancies associated with GAD and low social support
  - Worst outcomes for planned pregnancies that were subsequently deemed poorly timed
- Findings support screening for unplanned/poorly timed pregnancy during prenatal care

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Table 1

Sample characteristics by maternal mental health outcomes

	TOTAL	MDE in pregnancy			GAD in pregnancy			CPSS ≥20			MKSSI≤3.2		
Characteristic	**2654 (100)**	**Yes n=222**	**No n=2432**	**p-value**	**Yes n=252**	**No n=2402**	**p-value**	**Yes n=726**	**No n=1913**	**p-value**	**Yes n=623**	**No n-2031**	**p-value**
Mean age in yrs (SD)	31 (5.7)	29.2 (5.9)	31.1 (5.7)	<0.0001	30.7 (5.6)	31.0 (5.7)	0.5130	29.7 (6.1)	31.4 (5.5)	<0.0001	30.2 (6.2)	31.2 (5.6)	0.0002
Age (yrs)													
<25	438 (16.5)	57 (25.7)	381 (15.7)	<0.0001	43 (17.1)	395 (16.5)	0.7965	175 (24.1)	256 (13.4)	<0.0001	143 (23.0)	295 (14.5)	<0.0001
25–29	632 (23.8)	63 (28.4)	569 (23.4)		62 (24.7)	570 (23.7)		183 (25.2)	446 (23.3)		142 (22.8)	490 (24.2)	
30–34	877 (33.1)	64 (28.8)	813 (33.5)		86 (34.3)	791 (32.9)		201 (27.)	674 (35.3)		178 (28.6)	699 (34.4)	
35+	705 (2.6)	38 (17.1)	667 (27.4)		60 (23.9)	645 (26.9)		167 (230)	535 (28.0)		160 (25. 7)	545 (26.9)	
Race/ethnicity													
White	1957 (73.7)	115 (51.8)	1842 (75.7)	<0.0001	172 (68.3)	1785 (74.3)	0.0007	465 (64.1)	1488 (77.8)	<0.0001	405 (65.0)	1552 (76.4)	<0.0001
Hispanic	383 (14.4)	58 (26.1)	325 (13.4)		37 (14.7)	346 (14.4)		148 (20.4)	226 (11.8)		119 (19.1)	264 (13.0)	
Black	195 (7.4)	40 (18.0)	155 (6.4)		36 (14.3)	159 (6.6)		85 (11.7)	109 (5.7)		68 (10.9)	127 (6.3)	
Asian	82 (3.1)	4 (1.8)	78 (3.2)		5 (2.0)	77 (3.2)		16 (2.2)	66 (3.5)		19 (3.1)	63 (3.1)	
Mixed, other	37 (1.4)	5 (2.3)	32 (1.3)		2 (0.8)	35 (1.5)		12 (1.7)	24 (1.3)		12 (1.9)	25 (1.2)	
Marital Status													
Married	1889 (71.2)	108 (48.7)	1781 (73.2)	<0.0001	141 (56.0)	1748 (72.8)	<0.0001	395 (54.4)	1488 (77.8)	<0.0001	361 (57.9)	1528 (75.2)	<0.0001
Living with partner	425 (16.0)	54 (24.3)	371 (15.3)		64 (25.4)	361 (15.0)		168 (23.1)	252 (13.2)		130 (20.9)	295 (14.5)	
Never married Divorced, separated, widowed	275 (10.4)	14 (6.3)	51 (2.1)		34 (13.5)	241 (10.0)		128 (17.6)	144 (7.5)		103 (16.5)	172 (8.5)	
	65 (2.4)	46 (20.7)	229 (9.4)		13 (5.2)	52 (2.2)		35 (4.8)	29 (1.5)		29 (4.7)	36 (1.8)	
Education (yrs)													
<12	172 (6.5)	29 (13.1)	143 (5.9)	<0.0001	25 (9.9)	147 (6.1)	<0.0001	78 (10.7)	90 (4.7)	<0.0001	72 (11.6)	100 (4.9)	<0.0001
12	382 (14.4)	51 (23.0)	331 (13.6)		39 (15.5)	343 (14.3)		148 (20.4)	231 (12.1)		131 (21.0)	251 (12.4)	
13–15	599 (22.6)	64 (28.8)	535 (22.0)		78 (31.0)	521 (21.7)		202 (27.8)	394 (20.6)		144 (23.1)	455 (22.4)	
16+	1501 (56.6)	78 (35.1)	1423 (58.5)		110 (43.6)	1391 (57.9)		298 (41.1)	1198 (62.6)		276 (44.3)	1225 (60.3)	
Parity													
0	1140 (43.0)	91 (41.0)	1049 (43.1)	0.0028	104 (41.3)	1036 (43.1)	0.6092	296 (40.8)	838 (43.8)	0.0003	226 (36.3)	914 (45.0)	<0.0001
1	954 (35.0)	69 (31.1)	885 (36.4)		94 (37.3)	860 (35.8)		239 (32.9)	707 (37.0)		229 (36.8)	725 (35.7)	
2	412 (15.5)	38 (17.1)	374 (15.4)		36 (14.3)	376 (15.7)		133 (18.3)	279 (14.6)		117 (18.8)	295 (14.5)	

Characteristic	TOTAL 2654 (100)	MDE in pregnancy Yes n=222	MDE in pregnancy No n=2432	p-value	GAD in pregnancy Yes n=252	GAD in pregnancy No n=2402	p-value	CPSS ≥20 Yes n=726	CPSS ≥20 No n=1913	p-value	MKSSI≤3.2 Yes n=623	MKSSI≤3.2 No n-2031	p-value
3+	148 (5.6)	24 (10.8)	124 (5.1)		18 (7.1)	130 (5.4)		58 (8.0)	89 (4.7)		51 (8.2)	97 (4.8)	
Preterm birth history													
No preterm births	1306 (49.2)	106 (47.7)	1200 (49.3)	0.1390	124 (49.2)	1182 (49.2)	0.5503	355 (48.9)	943 (49.3)	0.0109	338 (54.3)	968 (47.7)	0.0004
Preterm births	208 (7.8)	25 (11.3)	183 (7.5)		24 (9.5)	184 (7.7)		75 (10.3)	132 (6.9)		59 (9.5)	149 (7.3)	
No previous live births	1140 (43.0)	91 (41.0)	1049 (43.1)		104 (41.3)	1036 (43.1)		296 (40.8)	838 (43.8)		226 (36.3)	914 (45.0)	
Smoke in pregnancy													
Yes	389 (14.7)	54 (24.3)	335 (13.8)	<0.0001	67 (26.6)	322 (13.4)	<0.0001	175 (24.1)	211 (11.0)	<0.0001	132 (21.2)	257 (12.7)	<0.0001
No	2265 (85.3)	168 (75.7)	2097 (86.2)		185 (73.4)	2080 (86.6)		551 (75.9)	1702 (89.0)		491 (78.8)	1774 (87.4)	
Substance use in pregnancy													
Yes	209 (7.9)	32 (14.4)	177 (7.3)	0.0002	38 (15.1)	171 (7.1)	<0.0001	93 (12.8)	116 (6.1)	<0.0001	75 (12.0)	134 (6.6)	<0.0001
No	2445 (92.1)	190 (85.6)	2255 (92.7)		214 (84.9)	2231(92.9)		633 (87.2)	1797 (93.9)		548 (88.0)	1897 (93.4)	
Alcohol use in pregnancy (>4drinks/wk)													
Yes	24 (0.9)	6 (2.7)	18 (0.7)	0.0031	2 (0.8)	22 (0.9)	0.8454	11 (1.5)	13 (0.7)	0.0435	8 (1.3)	16 (0.8)	0.2523
No	2630 (99.1)	216 (97.3)	2414 (99.3)		250 (99.2)	2380 (99.1)		715 (98.5)	1900 (99.3)		615 (98.7)	2015 (99.2)	
Benzodiazapene use during pregnancy													
Yes	67 (2.5)	15 (6.8)	52 (2.1)	<0.0001	19 (7.5)	48 (2.0)	<0.0001	37 (5.1)	30 (1.6)	<0.0001	18 (2.9)	49 (2.4)	0.507
No	2587 (97.5)	207 (93.2)	2380 (97.9)		233 (92.5)	2354 (98.0)		689 (94.9)	1883 (98.4)		605 (97.1)	1982 (97.6)	
Panic disorder during pregnancy													
Yes	98 (3.7)	31 (14.0)	67 (2.8)	<0.0001	37 (14.7)	61 (2.5)	<0.0001	60 (8.3)	38 (2.0)	<0.0001	40 (6.4)	58 (2.9)	<0.0001
No	2556 (96.3)	191 (86.0)	2365 (97.2)		215 (85.3)	2341 (97.5)		666 (91.7)	1875 (98.0)		583 (93.6)	1973 (97.1)	
Sexual abuse/molestation prior to age 18													
Yes	437 (16.8)	77 (36.7)	360 (15.0)	<0.0001	77 (31.7)	360 (15.2)	<0.0001	186 (26.4)	246 (13.0)	<0.0001	170 (28.2)	267 (13.3)	<0.0001
No	2172 (83.3)	133 (63.3)	2039 (85.0)		166 (68.3)	2006 (84.8)		518 (73.6)	1645 (87.0)		432 (71.8)	1740 (86.7)	
Posttraumatic stress disorder													
Yes	129 (4.9)	51 (23.0)	78 (3.2)	<0.0001	57 (22.6)	72 (3.0)	<0.0001	99 (13.6)	30 (1.6)	<0. 0001	50 (8.0)	79 (3.9)	<0.0001
No	2525 (95.1)	171 (77.0)	2354 (96.8)		195 (77.4)	2330 (97.0)		627 (86.4)	1883 (98.4)		573 (92.0)	1952 (96.1)	
Ever diagnosed with a chronic medical condition§													

Characteristic	TOTAL 2654 (100)	MDE in pregnancy Yes n=222	MDE in pregnancy No n=2432	p-value	GAD in pregnancy Yes n=252	GAD in pregnancy No n=2402	p-value	CPSS ≥20 Yes n=726	CPSS ≥20 No n=1913	p-value	MKSSI≤3.2 Yes n=623	MKSSI≤3.2 No n-2031	p-value
Yes	904 (34.1)	96 (43.2)	808 (33.2)	0.0026	105 (41.7)	799 (33.3)	0.0074	281 (38.7)	616 (32.2)	0.0016	232 (37.2)	672 (33.1)	0.0558
No	1750 (65.9)	126 (56.8)	1624 (66.8)		147 (58.3)	1603 (66.7)		445 (61.3)	1297 (67.8)		391 (62.8)	1359 (66.9)	
Hospitalization with overnight stay 12 mons before pregnancy													
Yes	292 (11.0)	38 (17.1)	254 (10.5)	0.0025	32 (12.7)	260 (10.9)	0.372	107 (14.7)	180 (9.4)	<0. 0001	76 (12.2)	216 (10.7)	0.2764
No	2357 (89.0)	184 (82.9)	2173 (89.5)		220 (87.3)	2137 (89.2)		619 (85.3)	1733 (90.6)		546 (87.8)	1811 (89.3)	
Pregnancy Planning													
Unplanned	987 (37.2)	131 (59.0)	856 (35.2)	<0.0001	126 (50.0)	861 (35.9)	<0.0001	397 (54.8)	581 (30.4)	<0. 0001	278 (44.8)	709 (34.9)	<0.0001
Planned	1664 (62.8)	91 (41.0)	1573 (64.8)		126 (50.0)	1538 (64.1)		328 (45.2)	1330 (69.6)		343 (55.2)	1321 (65.1)	
Pregnancy Timing													
Not a good time	343 (13.0)	85 (39.0)	258 (10.7)	<0.0001	58 (23.5)	285 (12.0)	<0.0001	225 (31.5)	114 (6.0)	<0. 0001	141 (22.9)	202 (10.0)	<0.0001
Good time	2288 (87.0)	133 (61.0)	2155 (89.3)		189 (76.5)	2099 (88.0)		490 (68.5)	1787 (94.0)		474 (77.1)	1814 (90.0)	
Planning and Timing													
Unplanned/bad time	285 (10.8)	70 (32.1)	215 (8.9)	<0.0001	47 (19.0)	238 (10.0)	<0.0001	187 (26.2)	94 (5.0)	<0. 0001	110 (17.9)	175 (8.7)	<0.0001
Unplanned/good time	684 (26.0)	57 (26.2)	627 (26.0)		75 (30.4)	609 (25.6)		201 (28.2)	478 (25.2)		161 (26.3)	523 (26.0)	
Planned/bad time	57 (2.2)	15 (6.9)	42 (1.7)		11 (4.5)	46 (1.9)		37 (5.2)	20 (1.1)		30 (4.9)	27 (1.3)	
Planned/good time	1602 (61.0)	76 (34.9)	1526 (63.3)		114 (46.2)	1488 (62.5)		289 (40.5)	1307 (68.8)		312 (50.9)	1290 (64.0)	

t-test used for continuous variables; χ^2 for categorical variables

Table 2

Unadjusted estimates for pregnancy planning/pregnancy timing and mental health outcomes

	MDE in pregnancy			GAD in pregnancy			CPSS ≥20			MKSSI≤3.2		
	n (%)	OR	95%CI	n (%)	OR	95%CI	n (%)	OR	95%CI	n (%)	OR	95%CI
Pregnancy Planning												
Unplanned	131 (13.3)	2.65***	2.00–3.50	126 (12.8)	1.79***	1.38–2.32	397 (40.6)	2.77***	2.32–3.30	278 (28.2)	1.51***	1.26–1.81
Planned	91 (5.5)	Ref		126 (7.6)	Ref		328 (19.8)	Ref		343 (20.6)	Ref	
Pregnancy Timing												
Not a good time	85 (24.8)	5.34***	3.95–7.22	58 (16.9)	2.26***	1.64–3.11	225 (66.4)	7.20***	5.63–9.21	141 (41.1)	2.67***	2.11–3.39
Good time	133 (5.8)	Ref		189 (8.3)	Ref		490 (21.5)	Ref		474 (20.7)	Ref	
Planning and Timing												
Unplanned/Bad time	70 (24.6)	6.54***	4.59–9.32	47 (16.5)	2.58***	1.79–3.72	187 (66.6)	8.99***	6.81–11.89	110 (38.6)	2.60***	1.99–3.40
Unplanned/Good time	57 (8.3)	1.83***	1.28–2.61	75 (11.0)	1.61**	1.18–2.18	201 (29.6)	1.90***	1.54–2.34	161 (23.5)	1.27*	1.03–1.60
Planned/Bad time	15 (26.3)	7.17***	3.81–13.50	11 (19.3)	3.12**	1.57–6.19	37 (64.9)	8.37***	4.79–14.63	30 (52.6)	4.59***	2.69–7.84
Planned/Good time	76 (4.7)	Ref		114 (7.1)	Ref		289 (18.1)	Ref		312 (19.5)	Ref	

*p<0.05;

**p<0.01;

***p<0.001

Table 3

Adjusted odds ratio estimates for pregnancy planning/pregnancy timing and maternal mental health outcomes

	MDD in pregnancy		GAD in pregnancy		CPSS≥20		KSSI≤3.2	
	aOR	**95%CI**	**aOR**	**95%CI**	**aOR**	**95%CI**	**aOR**	**95%CI**
Pregnancy Planning								
Unplanned	1.69[a]**	1.23–2.32	1.28[c]	0.92–1.79	1.74[e]***	1.40–2.16	0.85[g]	0.68–1.07
Planned	Ref		Ref		Ref		Ref	
Pregnancy Timing								
Not a good time	3.47[b]***	2.46–4.91		1.07–2.40	5.20[f]***	3.93–6.87	1.64[h]***	1.25–2.16
Good time	Ref		Ref		Ref		Ref	
Planning and Timing								
Unplanned/Bad time	3.70***	2.46–5.58	1.73*	1.06–2.81	6.03***	4.35–8.38	1.24	0.89–1.73
Unplanned/Good time	1.31	0.88–1.94	1.26	0.87–1.83	1.41**	1.11–1.80	0.84	0.65–1.08
Planned/Bad time	5.08***	2.52–10.25	2.28*	1.04–5.03	6.48***	3.59–11.69	3.19***	1.81–5.62
Planned/Good time	Ref		Ref		Ref		Ref	

*p<0.05;

**p<0.01;

***p<0.001

[a]n=2599; adjusted for race/ethnicity, alcohol use, benzodiazepine use, panic disorder, sexual abuse prior to age 18, ptsd during pregnancy

[b]n=2579; adjusted for race/ethnicity, alcohol use, benzodiazepine use, panic disorder, sexual abuse prior to age 18, ptsd during pregnancy

[c]n=2599; adjusted for age, marital status, parity, smoking, benzodiazepine use, panic disorder, sexual abuse prior to age 18, ptsd during pregnancy

[d]n=2579; adjusted for age, race/ethnicity, marital status, parity, smoking, benzodiazepine use, panic disorder, sexual abuse prior to age 18, ptsd during pregnancy

[e]n=2590; adjusted for education, marital status, benzodiazepine use, panic disorder, sexual abuse prior to age 18, hospitalization in year before pregnancy, ptsd during pregnancy

[f]n=2570; adjusted for marital status, smoking, benzodiazepine use, panic disorder, sexual abuse prior to age 18, hospitalization year prior to pregnancy, ptsd during pregnancy

[g]n=2599; adjusted for education, marital status, substance use, panic disorder, sexual abuse prior to age 18

[h]n=2579; adjusted for education, marital status, parity, panic disorder, sexual abuse prior to age 18

4 level planning and timing variable models:
MDE: n=2576; adjusted for race/ethnicity, alcohol use, benzodiazepine use, panic disorder, sexual abuse prior to age 18, ptsd during pregnancy
GAD: n=2576; adjusted for age, marital status, parity, smoking, benzodiazepine use, panic disorder, sexual abuse prior to age 18, ptsd during pregnancy
CPSS: n=2567; adjusted for marital status, smoking, benzodiazipene use, panic disorder, sexual abuse prior to age 18, hospitalization yr before pregnancy, ptsd during pregnancy
MKSSI: n=2576; adjusted for education, marital status, parity, panic disorder, sexual abuse prior to age 18