

ABSTRACT

Title of Dissertation: THE EFFECT OF DEPRESSION ON
WOMEN'S CONTRACEPTIVE BEHAVIORS
AND TEENAGE PREGNANCY

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Objective: The overall objective of this dissertation was to investigate the effect of depression on women's contraceptive behaviors and teenage pregnancy.

Methods: In the first study, the relationship between pre-abortion depressive symptoms and effectiveness level of contraceptive method chosen (low, moderately, or highly effective) after contraceptive counseling was examined using multinomial logistic regression in a group of women seeking abortion services. In the second study Cox proportional hazards models were used to estimate the hazard of contraceptive method discontinuation and unintended pregnancy among women experiencing any current and past elevated depressive symptoms in reproductive health settings. The third study examined the association between first depressive episode relative to age at first sex, and the hazard of first teenage pregnancy among girls participating in the National Comorbidity Survey–Adolescent Supplement.

Results: More pre-abortion depressive symptoms were associated with higher odds of choosing a low contraceptive method than a moderately or a highly effective

contraceptive method. Compared to non-depressed women, women exposed to baseline and a history of elevated depressive symptoms and those exposed to a history of elevated depressive symptoms had 39% and 12% increased hazards of contraceptive method discontinuation respectively; though the associations were not statistically significant when examining all contraceptive methods together. These associations were significant among patch and the injectable users. Finally, adolescent girls whose first depressive episode occurred at the same age as their sexual debut had a higher likelihood of experiencing first teenage pregnancy (HR: 2.73, 95% CI 1.07, 6.97) than those experiencing no depression onset. **Conclusion:** This dissertation provides evidence for the critical role of timing of depression in determining women's contraceptive behaviors and reproductive decisions. The findings collectively suggest that not only the presence or absence of depression, but also the time the condition manifests itself during the course of women's lives can predict women's decisions surrounding contraceptive method choice, continuation, and pregnancy. **Implications:** The integration of mental and reproductive health as well as a more effective patient-physician communication are warranted in an effort to optimize pregnancy outcomes in women at risk for depression.

THE EFFECT OF DEPRESSION ON WOMEN'S CONTRACEPTIVE
BEHAVIORS AND TEENAGE PREGNANCY

by

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Chapter 1: Introduction

Overview

Almost fifty percent of all pregnancies in the United States are unintended and about 40% of them end in abortion (Finer & Zolna, 2016). The Centers for Disease Control and Prevention (CDC) defines an unintended pregnancy as a pregnancy that is unwanted—a pregnancy occurring when no children or no more children are desired—or mistimed—a pregnancy occurring earlier than desired (Centers for Disease Control and Prevention, 2015). Unmarried women, women 18-24 years old, those from minority backgrounds, those with lower incomes, and those having an abortion are more likely to experience unintended pregnancy in the United States (Finer & Zolna, 2016; Jones & Kavanaugh, 2011; Upadhyay, Brown, Sokoloff, & Raine, 2012).

Unintended pregnancies are associated with adverse health outcomes for mothers and their children. Women experiencing unwanted pregnancies are more likely to delay seeking prenatal care services, to have perinatal depression, to have lower educational attainment, and to have fewer career opportunities (Bahk, Yun, Kim, & Khang, 2015; Chang, Schwarz, Douglas, & Horon, 2009; Chiquero, 2010; Ferre, Gerstenbluth, Rossi, & Triunfo, 2013; Gipson, Koenig, & Hindin, 2008). Children born as a consequence of unintended pregnancies are at higher risk for experiencing child abuse and violence, delayed cognitive development during childhood, and psychiatric problems, and low self-esteem in adulthood (Axinn, Barber, & Thornton, 1998; Carson et al., 2013; De La Rochebrochard & Joshi, 2013).

Contraceptive behaviors are important determinants of unintended pregnancy. Forty-three percent of unintended pregnancies in the United States occur among contraceptive users while only about 5% of unintended pregnancies are the result of contraceptive method failure (Sonfield, Hasstedt, & Gold, 2014). Another 42% of unintended pregnancies are among those not using any method at the time they became pregnant (Sonfield, Hasstedt, & Gold, 2014). The failure rate of the typical contraceptive method use differs by method and is based on users' behaviors (Trussell, 2011). Therefore, promoting the initiation and continuous use of effective contraceptive methods could help in preventing unintended pregnancy, particularly among women at high risk for unintended pregnancy.

There are many factors influencing contraceptive method choice and accurate, consistent, and continuous use of contraceptives including women's personal and intimate relationship characteristics, pregnancy desires, social and economic factors, access to services, and women's attitudes and experiences towards using different contraceptive methods and their effectiveness (Frost & Darroch, 2008; Hall et al., 2013b; Jones, Tapales, Lindberg, & Frost, 2015; Manlove, Ryan, & Franzetta, 2004; Moreau, Hall, Trussell, & Barber, 2013; Marrison et al., 2016). In addition, some research has shown mental health, in particular depression, to be associated with women's contraceptive behaviors (Garber et al., 2010; Steinberg et al., 2013) and unintended pregnancy (e.g. Hall et al., 2017). However, gaps in the literature on the link between women's mental health and their contraceptive behaviors and reproductive decision-making still exist. In particular, is it not clear whether the timing and persistence of depression can influence women's decision on the type of

contraceptive method, their compliance with the method of their choice, and pregnancy.

Unintended Pregnancy

The term unintended pregnancy is defined as a pregnancy that is either mistimed or unwanted at the time of conception (CDC, 2015; Logan et al. 2007). If a pregnancy occurs at a time when the woman did not want to become pregnant but she did want to become pregnant at some point in the future, the pregnancy is classified as mistimed. If a woman did not want to become pregnant at the time of conception or at any time in the future, then the pregnancy is considered unwanted (Finer & Zolna, 2014). According to the latest national records, in 2011, 45% of all pregnancies, in the United States, were unintended, a six percentage point decline from 2008 (Finer & Zolna, 2016). Despite these declines, unintended pregnancy rates in the United States are much higher than other industrialized countries (Sedgh, Singh, & Hussain, 2014). Furthermore, disparities in rates of unintended pregnancy based on women's demographic characteristics still exist (Finer & Zolna, 2016).

Young women are more likely to experience unintended pregnancy. In 2011, the rate of unintended pregnancy was highest among women 20-24 years old at 81 per 1000 women in this age group and lowest among women 35 years and older at 16 per 1000 women (Finer & Zolna, 2016; Finer & Zolna, 2014). Racial differences are also seen in rates of unintended pregnancy. Although there was a reduction in the rate of unintended pregnancy among all racial and ethnic groups from 2008 to 2011, black non-Hispanic women still had the highest rate of unintended pregnancy compared to white non-Hispanic women who had the lowest rate of unintended pregnancy (Finer

& Zolna, 2016; Finer & Zolna, 2014). Low educational attainment and low-income levels are also associated with higher rates of unintended pregnancy. In 2011, poor women and women with less than a high school education experienced the highest percentages of unintended pregnancies compared to women with a college degree and income above 200% of the federal poverty level (Finer & Zolna, 2016).

Among unintended pregnancies ending in childbirth in the United States, there was an overall 18% reduction between 2008 and 2011 (Finer & Zolna, 2016).

Alternatively, the proportion of abortions due to unintended pregnancies, showed a two-percentage point increase, in the 2008-2011 time period (Finer & Zolna, 2016).

Younger, unmarried, minority women, and those with income 100% below poverty level are at higher risk for abortions (Jones & Kavanaugh, 2011). In addition, 50% of women having an abortion have experienced an abortion before (Jones, Singh, Finer, & Frohwirth, 2006), and compared to women who are not having abortions, women experiencing an abortion are at a higher risk for becoming pregnant in the following year (Upadhyay, Brown, Sokoloff, & Raine, 2012).

One of the main objectives in public health is to reduce the health risks related to their specific conditions. Experiences of pregnancy and childbirth are such conditions in which women often underestimate the maternal and perinatal health risks (Berg, MacKay, Qin, & Callaghan, 2009; Collaghan, Creanga, & Kuklina, 2012; Grotegut et al., 2014; Jolly, Sebire, Harris, Robinson, & Regan, 2000; Nelson & Rezvan, 2012; Speidel, Rocca, Thompson, & Harper, 2013). This lack of knowledge about pregnancy and childbirth can adversely affect reproductive decision-making by women underestimating their chances of becoming pregnant, which may then

influence their contraceptive behaviors (Biggs & Foster, 2012). Therefore, by recognizing the potential health risk factors related to pregnancy and childbirth, women can decrease their risk of pregnancy complications through preventing unintended pregnancies (Speidel et al, 2013).

Experiencing unintended pregnancy ending in birth is associated with several behavioral and health outcomes for women and their children, during and after pregnancy. Compared to those with an intentional pregnancy, women experiencing unintended pregnancies are more likely to delay prenatal care visits (Cheng et al., 2009; Hulsey, Laken, Miller, & Ager, 2000; Logan et al. 2007), or engage in unhealthy behaviors during the prenatal period (Cheng et al., 2009; Orr, James, & Reiter, 2008). Using the national Pregnancy Risk Assessment Monitoring System (PRAMS), one study showed increased risks of smoking and being subject to domestic violence during pregnancy, and not-breastfeeding during the postpartum period in women with an unintended pregnancy (D'Angelo et al., 2004).

A number of studies investigating the impact of unintended pregnancies carried to term on maternal mental health have found an association between unintended pregnancy and more post-pregnancy mental health problems in women (Bahk, Yun, Kim, & Khang, 2015; Beck, 2001; Gipson, Koenig, & Hindin, 2008; Lancaster et al., 2010; Tabet, Flick, Cook, Xian, & Change, 2016). Using Maryland's PRAMS data, Cheng and colleagues found that women whose pregnancies were mistimed or unwanted were at a higher risk for reporting postpartum depression compared to women with intended pregnancies (Cheng et al., 2009). Studies looking at the long-term effects of unintended pregnancy on maternal mental health have also

found a positive association between unintended pregnancies ending in childbirth and later life depressive symptoms (Bahk et al., 2015; Herd, Higgins, Sicinski, & Merkurieva, 2016; Tabet et al., 2016).

In addition to women, children who are born as the result of an unintended pregnancy experience negative outcomes. Using data from the National Longitudinal Survey of Youth (NLSY), Baydar found that children aged 1-2 years old born as a result of unplanned pregnancies are more likely to live away from their biological fathers and live in lower income households than children from planned pregnancies. Furthermore, children one or older born from an unintended pregnancy were provided with less resources at home for learning and developing skills, were more fearful, and had less receptive vocabulary (Baydar, 1995). Cognitive delays have also been seen in children resulting from unintended pregnancies (De La Rochebrochard & Joshi, 2013).

In addition to influencing maternal and child health, unintended pregnancy can also lead to economic costs for society. Trussell and colleagues estimated the annual total direct cost of unintended pregnancies in the United States to be \$5.0 billion, which includes the costs of births, induced abortions, and fetal losses (Trussell, 2007). In fact, preventing unintended pregnancies through provision of family planning services, pregnancy prevention programs, and media campaigns to encourage contraceptive use could be very cost effective (Monea & Thomas, 2011; Thomas, 2010; Tsui, McDonald-Mosley, & Burke, 2010). Moreover, Amaral and colleagues found that preventing unintended pregnancies could save the state of

California \$2.76 billion within 2 years and \$5.33 billion within 5 years (Amaral et al., 2007).

Teenage Pregnancy

During the time period of 2011-2013, 44% of unmarried 15-19 years old girls in the United States reported having had sexual intercourse and 13% of never-married girls reported having had sex before the age of 15 (Martinez & Abma, 2015). Sexual debut marks an important event in the lives of adolescent girls by placing them at risk for pregnancy. Teen pregnancy is defined as a pregnancy occurring in an adolescent girl between the ages of 13-19 (United Nations International Children's Emergency Fund, 2008). Based on the latest national data in 2011, the pregnancy rate among adolescent girls 15-19 years old in the United States was 55 pregnancies per 1000 women, a 21% decrease from 2008 (Finer & Zolna, 2016). Despite this decline, the rate of pregnancy among adolescents in the United States is still higher than other developed countries and racial differences also exist (Sedgh, Finer, Bankole, Eilers, & Singh, 2015; US Department of Health and Human Services, 2016). Factors such as living in low-income households, living in rural areas, low parental education, being from a minority background, and younger age at first sex are associated with teenage pregnancy (Dehlendorf, Rodriguez, Levy, Borrero, & Sterinauer, 2010; Hall et al., 2017; WHO, 2014).

For some adolescents pregnancy is planned and wanted while for others it is not (World Health Organization, 2014). In the United States, the majority (75%) of the pregnancies in this age group, in 2011, were unintended (Finer & Zolna, 2016), which poses a great public health concern (Scally, 2002). In addition to the negative

effects of unintended pregnancy on general maternal and child health previously discussed, unintended pregnancy in teenagers poses unique challenges to adolescent mothers and their children. Adolescents are more likely to have shorter inter-pregnancy intervals than adult women (Katz et al, 2011). A systematic review of studies looking at teenage pregnancy indicates that among adolescent mothers, on average, approximately 19% within 12 months and 40% within 18 months became pregnant again (Meade, & Ickovics, 2004). Furthermore, children born to teenage mothers are more likely to be pre-term, have low birth weight and become teenage mothers compared to children of adult mothers (Chen et al., 2007; Langille, 2007).

Considering the adverse effects of unintended and teenage pregnancies on maternal and child health, investigating risk factors contributing to these outcomes beyond women's socio-demographic characteristics is warranted. Previous research has shown that women's contraceptive behaviors can directly influence their risk of unintended pregnancy (Blumenthal et al., 1994; Forrest, 1994). The latest national data on women's contraceptive behaviors indicate that 95% of unintended pregnancies in the United States result from non-use, or incorrect or inconsistent use of contraceptive methods (Sonfield, Hasstedt, & Gold, 2014). Therefore, understanding determinants of women's contraceptive behaviors is important for preventing unintended pregnancy.

Contraception

Family planning, described as pregnancy planning, is considered one of the greatest public health achievements of the 20th century. Planning when to have a child can improve the overall health of infants, children, and women by controlling

birth spacing, family size, and reducing unintended pregnancies (CDC, 2015; United States Department of Health & Human Services, 2014). Women, in the United States, spend a large portion of their reproductive years trying to avoid pregnancy (Gold, Sonfield, Richards, & Frost, 2009). Studies have shown that a typical American woman experiences her first sexual intercourse at the median age of 17, her first pregnancy at the median age of 22.5, her first childbirth at the median age of 26, and menopause at the median age of 51 (Gold et al, 2009). Furthermore, by 31 years of age, half of women desire no more children (Gold et al, 2009). Therefore, women attempt to prevent pregnancy and childbearing for more than two decades of their lives (Gold et al, 2009), and their contraceptive behaviors during this time period are indicative of whether they will experience an unintended pregnancy.

There are different traditional and modern family planning and contraceptive methods used by women and couples to avoid pregnancy. Traditional methods of contraception include abstinence, fertility awareness based method (FAM), and withdrawal, and modern contraceptive methods include spermicides, the sponge, female and male condoms, the diaphragm, the patch, the vaginal ring, the Depo-Provera (DMPA) injection, oral contraceptive pills, intrauterine devices (IUDs), implants, and female and male sterilization (Hatcher et al., 1998). All of these methods with the exception of female and male sterilization are reversible. Each method has a different rate of effectiveness in preventing pregnancy which is directly associated with the contraceptive behaviors of the individual using the method. Perfect use indicates how effective a contraceptive method is at preventing pregnancy if the user implements the method consistently and correctly at every single sexual

encounter. Typical use, on the other hand, is an indication of contraceptive method effectiveness at preventing pregnancy based on the actual use of the method by users, which may be inaccurate and inconsistent (Trussell, 2011). For instance, the long acting reversible contraceptive methods (LARCs) including implants and IUDs are considered the most effective reversible methods because they do not require user adherence to the method and therefore their failure rates (rates at which women become pregnant) based on typical and perfect use are similar at less than one pregnancy per 100 women in a year (Trussell, 2011). The DMPA injection, oral contraceptive pills, the patch, and the vaginal ring are associated with 6-12 pregnancies per 100 women per year based on a typical use compared to less than one per 100 women per year based on perfect use. Male condoms, FAM, the sponge, spermicides, and withdrawal are considered the least effective contraceptive methods as they are associated with 13-28 pregnancies per 100 women per year based on typical use versus 2-18 based on perfect use (Jaccard, 2009; Trussell, 2011).

Almost all sexually experienced women in the United States use a form (traditional or modern) of contraception at some point in their lives (Daniels, Mosher, & Jones, 2013). Based on the latest national data from 2011-2013, about 62% of all women 15-44 years old in the United States were currently using a form of contraception (Daniels, Daughtery, & Jones, 2014). The three most common contraceptive methods used in 2013 were oral contraceptives, female sterilization, and male condoms that were used by 16%, 15.5%, and 9.4% of all women respectively (Daniels et al., 2015). The type of contraceptive methods used, however, varied by women's demographic characteristics. In 2011-2013, the reversible

contraceptive methods including oral contraceptives and male condoms were the most common methods used by women aged 15-24 years, while female and male sterilization were the most common methods used by women aged 35-44 years. Being of white non-Hispanic background, holding a college education or higher, never having been married, and having no children were positively associated with the use of oral contraceptives among women (Daniels et al., 2015). Furthermore, current contraceptive use was highest among white non-Hispanic women (65.3%), and women with some college education (69.2%), (Daniels et al., 2014).

Despite being the most effective reversible contraceptive methods, LARCs (IUDs and implant) are not the most common reversible methods used among women. However, population based studies show an increasing trend in the use of LARC methods over the past decade among all women of reproductive age, particularly younger and low-income women who are at higher risk for unintended pregnancy (Finer, Jerman, & Kavanaugh, 2012; Kavanaugh, Jerman, & Finer, 2015). In 2012, the use of LARC methods was highest among women 25-34 years old, foreign born women, and women with one or two previous births, and 89% of LARC users used an IUD compared to 11% who used an implant (Kavanaugh, Jerman, & Finer, 2015).

Although oral contraceptives and condoms are the most common reversible contraceptive methods used in the United States, women may not use these methods consistently or correctly when trying to avoid pregnancy (Daniels et al., 2015; Finer & Zolna, 2014). Population based projections have shown that over half of American women will experience an unintended pregnancy and 30% will experience an

abortion by the age of 45 (Allen Guttmacher Institute, 2016; Jones & Kavanaugh, 2011). Research has also shown that 53% of unintended pregnancies occur due to nonuse while 42% are due to incorrect or inconsistent use, and only about 5% are the result of method failure during the months of conception (Frost & Darroch, 2008; Sonfield, Hasstedt, & Gold, 2014). These data show that contraceptive behaviors are key determinants of unwanted or mistimed pregnancies among women of reproductive age (Daniels, Daughtery, Jones, & Mosher, 2015), and merely promoting the uptake of contraceptives cannot address the problem of unintended pregnancies. Encouraging adherence to the contraceptive method regimen is also important in avoiding unwanted or mistimed pregnancies (Jaccord, 2009; Potter, Leon-Wong, & Canamar, 1996; Trussell, Vaughan, & Stanford, 1999).

Contraceptive behaviors of women consist of the choice of contraceptive method (both traditional and modern methods), accuracy in use, consistency and continuation of method, and switching between methods (Hynie & Lydon, 1996; Jaccord, Helbig, Wan, Gutman, & Kritz-Silverstein, 1996; Jaccard, 2009).

Contraceptive behaviors are, in part, influenced by individuals' knowledge about the contraceptive methods (Hynie & Lydon, 1996; Johnson, Pion, & Jennings, 2013).

Using the National Survey of Reproductive and Contraceptive Knowledge, which sampled men and women aged 18-29, Frost et al. (2012) found that women with more objective knowledge of different contraceptive methods had 9% lower odds of expecting to have unprotected sexual intercourse in the next three months preceding the survey ($p < 0.05$), 17% higher odds of currently using hormonal contraceptives ($p < 0.01$), and 17% lower odds of not using a contraceptive method ($p < 0.01$)

compared to women with less objective knowledge of contraceptive methods (Frost, Lindberg, & Finer, 2012).

Choice of contraceptive methods

For a woman, to obtain and use a contraceptive method, the first major step is to choose a method (Jaccard et al., 1996). Choice of a less effective contraceptive method can place women at a higher risk for unintended pregnancies (Jaccard, 2009; Jaccard & Levitz, 2013). The decision of what contraceptive method to obtain requires women's active choice of a contraceptive method and for most modern methods, women must make a visit to health care provider to obtain their chosen contraceptive method. Previous research has shown that patient-provider communication can influence women's contraceptive decision-making process (Wyatt et al., 2014). For some women the preferred decision making process is through a mutual agreement with their provider (Makoul & Clayman, 2006), while other women desire an autonomous decision making process with input from the provider on their specific concerns and questions (Dehlendorf, Diedrich, Drey, Postone, & Steinauer, 2010; Dehlendorf, Levy, Kelley, Grumbach, & Steinauer, 2013). Some factors that may influence women's decisions in choosing a particular contraceptive method include costs, concerns about side effects, dissatisfaction with specific methods, and ambivalence about becoming pregnant (Frost & Darroch, 2008). Therefore, the healthcare provider may play an important role in providing women with accurate information about different methods available and their effectiveness in preventing pregnancy, and helping women to critically evaluate and

ultimately choose which method is most appropriate for their life circumstances (Branden, 1998; Frost & Dorrach, 2008).

Contraceptive method continuation

Access to effective contraceptive methods helps enable women and couples to control the timing and spacing of their pregnancies, which in turn can lead to better maternal and child health outcomes (Kavanaugh & Anderson, 2013; Sonfield et al., 2014). Contraceptive continuation can be described as an individual using a method of contraception, though not always consistently and correctly, without stopping for a certain period of time (Jaccard et al., 1996). Despite an increase in the use of modern reversible contraceptive methods over the years, the rates of method continuation are still low (Peipert et al., 2011). Using a cohort of 1387 women aged 15-24 over a 12 month period, Raine et al examined the continuation rate of hormonal contraceptives including the patch, the ring, the pill, and the injection and found low continuation rates for all four contraceptive methods by 12 months follow up (18.5 women per 100 person-years), with the lowest rates of continuation for the patch and the injection initiators at 10.9 and 12.1 per 100 person-years ($p < 0.003$) respectively, and highest rates of continuation for oral contraceptive pill initiators at 32.7 per 100 person-years (Raine et al., 2011). Furthermore, using data from a randomized controlled trial of college and graduate students, Gilliam and colleagues found continuation rates of only 26% and 29% for oral contraceptives and vaginal rings at 6 months follow up from the baseline time point (Gilliam et al., 2010).

The continuation rates for LARC methods are higher compared to other contraceptive methods even though, as mentioned previously, they are not the most

common contraceptive methods used by women in the United States (Obijuru, Bumpus, Auinger, & Baldwin, 2016; Soriano, Wallander, Andersson, Filonenko, & Rodriguez, 2015). For instance, using data from the Contraceptive CHOICE Project, Peipert et al. found that the 12-month continuation rate of LARC methods was 88% compared to 55% for oral contraceptives (Peipert et al., 2013). Similarly, using the Contraceptive CHOICE Project data, Diedrich and colleagues found that the 3-year continuation rate for users of LARC methods (67.2%) was significantly higher than the rate for users of non-LARC methods (31%) (Diedrich, Zhao, Madden, Secura, & Peipert, 2015).

The low continuation rate of contraceptive methods increases women's risk of unintended pregnancy, posing an important national public health issue in the field of maternal and child health. Some factors associated with contraceptive method discontinuation include perceived weight change, other perceived side effects, dissatisfaction with contraceptive method, and feelings of ambivalence about becoming pregnant (Hall, O'Connell White, Rickert, Reame, & Westhoff, 2013c; O'Connell, Davis, & Kerns, 2007; Westhoff et al., 2008).

Accuracy, consistency, and switching in contraceptive use

Other contraceptive behaviors include accuracy of and consistency in method use, and switching between methods. Accuracy is an indication of the correctness in use of the chosen contraceptive method at every incident of sexual encounter (Jaccard & Levitz, 2013). Women with low perceived risk of becoming pregnant and negative attitudes toward a method are at higher risk of inaccurate contraceptive use (Jaccard et al., 1996).

Consistency in contraceptive use is the proportion of times an individual uses the contraceptive method of her choice relative to the total number of sexual encounters she experiences during a specific time period (Jaccard et al., 1996; Jaccard, 2009). For some forms of contraceptives, accuracy is equivalent to consistency in use. For instance, consistency in taking oral contraception includes remembering to take the pill as often as directed and obtaining refills of the prescription when needed (Jaccard, 2009). Factors such as minority race and ethnicity, younger age at first sexual intercourse, higher number of sexual partners, more sexual encounter, not expecting to have sexual intercourse at the time of incident, low desire for avoiding pregnancy, having fewer children, ambivalence about becoming pregnant, dissatisfaction with contraceptive method, and more stress and depressive symptoms have been shown to be associated with lower rates of consistent contraceptive use (Frost & Darroch, 2008; Hall et al., 2013b; Jones, Tapales, Lindberg, & Frost, 2015; Manlove, Ryan, & Franzetta, 2004; Moreau, Hall, Trussell, & Barber, 2013; Marrison et al., 2016).

Contraceptive switching can be described as when an individual changes from one method to another (Jaccard & Levitz, 2013). Periods between switching from one method to another can place the individual at risk for unintended pregnancy either because the individual is not using any method or is learning how to use the new method (Jaccard, 2009). Urban residency, higher levels of education, dissatisfaction with method of choice at contraception initiation, and concerns about the side effects are factors associated with contraceptive method switching (Curtis & Blanc, 1997; Grady, Billy, & Klepinger, 2002; Johnson, Pion, & Jennings, 2013; O'Fallon &

Speizer, 2011; Raine et al., 2011). Assisting women who decide to switch methods in choosing a more effective method can decrease the potential risk of unintended pregnancy (Frost & Darroch, 2008). For instance, women dissatisfied with a hormonal method other than LARCs are more likely to switch to a LARC method than women who were satisfied with the non-LARC hormonal method of their choice (Kavanaugh et al., 2015; Secura et al., 2010).

In addition to factors discussed above, women's mental health, particularly depression, has been shown to be associated with unintended and teen pregnancies, and contraceptive behaviors including method choice, continuation, and consistency (Daniels, et al, 2015; Francis et al. 2015; Frost et al, 2007; Frost et al., 2012; Garber et al., 2010; Hall, Richards, & Harris, 2017; Hall et al., 2014; Hall, Steinberg, Cwiak, Allen, & Marcus, 2015; Morrison et al., 2016; Raine et al., 2011; Steinberg et al., 2013; Steinberg & Rubin, 2014).

Depression

Depression is one of the most common mental health problems worldwide and it has a negative impact the lives of individuals (Bromet et al., 2011). In the United States, the population-based 12-month prevalence of major depression, for adults, is 6.6% (Center for Behavioral Health Statistics and Quality, 2015). Sex differences in depression rates also exist, with women being twice as likely as men to experience depression at some point in their lifetime (Kessler et al., 2003). According to the latest data from the National Comorbidity Survey Replication (NCS-R) the lifetime prevalence of major depression among women 18 or older is 20.2% compared to 13.2% in their male counterparts (Table 1, 2007). Racial differences in the rates of

depression may also exist, which could be attributable to social factors such as access to care and lack of health insurance in minority populations (Bailey, Patel, Barker, Ali, & Jabeen, 2011; Dunlop, Song, Lyons, Manheim, & Chang, 2003). Although depression is a common mental health problem in adults, it is also prevalent among adolescents 13-18 years of age, with a population based lifetime and 12-month prevalence of 11.0% and 7.5% respectively (Avenevoli, Swendsen, He, Burstein, & Merikangas, 2015). In particular, the lifetime prevalence of major depression among girls age 13-18 is approximately 16% compared to 7.7% in adolescent boys (National Comorbidity Survey, Appendix Tables 1&2, N.D.), raising a public health concern.

In non-pregnant women aged 18 and older, in the United States, the prevalence of major depression in a given year is estimated to be 8.1%—with a higher prevalence (15%) among low-income women compared to higher income women (2%) (Farr, Bitko, Hayes, & Dietz, 2010; Farr, Dietz, Williams, Gibbs, & Tregear, 2011a; Vesga-Lopez et al., 2008). A limited number of studies have looked at the correlates of depression among non-pregnant women. Using a sample of low income women aged 12-40, Berenson and colleagues found that current depression in women was associated with demographic factors such as minority race and ethnicity, younger age, less education, unemployment, and sexual or contraceptive health factors including having multiple sexual partners, first use of hormonal contraception at 12 years of age or younger, not using birth control at the last intercourse, and not having sex in the past three months (Berenson, Breitkopf, & Wu, 2003).

According to the World Health Organization's Global Burden of Disease study, depression is the leading cause of disability among women worldwide (World

Health Organization, 2004) and it may negatively influence women's reproductive health including their contraceptive behaviors and unintended pregnancy (Hall et al., 2015; Steinberg & Rubin, 2014). Depression leads to negative cognitive frameworks, lower self-efficacy, lower autonomy and self-agency, and lower motivation in individuals. The depression literature has shown that depression may alter the decision-making process in individuals (Hindmarch, Hotopf, & Owen, 2013). Depressed individuals may be indecisive or make judgments that are not based on rational thinking (Leahy, 2001; Leykin, Robersts, DeRubies, 2011). Depression may also decrease the individual's sense of self-efficacy and care leading the individual to underestimate their risk (Bandura, 1977; Beck, 1987; Sacco & Bykowski, 2010). Depression may also reduce motivation in individuals (Austin, Mitchell, & Goodwin, 2001) and therefore, it may increase the risk of medical non-compliance and adherence to prescription medication in women (DiMatteo, Lepper, & Croghan, 2000; Osterberg & Blaschke, 2005). Considering these mechanisms, depression may influence women's contraceptive behaviors in such a way that places them at a higher risk for experiencing unintended pregnancy. Therefore, further investigation of the association between depression and contraceptive behaviors, and pregnancy among women of reproductive age is warranted.

Overview of Studies

Studies comprising this dissertation are secondary analyses of three independent datasets. The first study examined the relationship between depressive symptoms and effectiveness level of contraceptive method chosen among 345 women

seeking abortion services in a cross sectional study (Steinberg, Tschann, Furgerson, & Harper, 2016).

Using time-to-event analysis, the second study investigated 1) the independent relationship between a combined past and baseline measurement of depressive symptoms and the hazard of contraceptive method discontinuation in a 12-month study period and 2) the independent relationship between a combined past and baseline measurement of depressive symptoms and the hazard of experiencing an unintended pregnancy during the same time period among women seeking family planning or abortion services in the prospective cohort of the National Trial of Contraceptive Acceptability Study (NTCAS) (Harper et al., 2015).

The third study investigated whether timing of depression onset with respect to age at sexual debut was associated with a higher probability of first pregnancy among adolescent girls 13-18 years old participating in the National Comorbidity Survey – Adolescent Supplement (NCS-A).

The use of time-to-event analysis is a novel approach in the context of this research topic. In present studies, time-to-event analysis is advantageous compared to ordinary logistic regression. In logistic regression the odds of the event is estimated in a fixed time period and the information from the subjects who have not completed the study period—those who left the study before the end of study period without experiencing the event—is unknown. Therefore the information pertaining to these subjects would not be considered in the calculation of the odds ratio. In time-to-event analysis, however, the hazard of the event is a function of time and the information from all subjects—including subjects who left the study before the end of study

period and did not experience the event—will be considered in the calculation of hazard ratio. This method will therefore produce more informative results about the association between depression and contraceptive behaviors or teenage pregnancy and is the preferred method in this dissertation.

Theoretical Framework: How Depression Influences Contraceptive Behaviors and Unintended/Teenage Pregnancy

Although the exact mechanisms by which depression may influence women's contraceptive behaviors and reproductive decision-making have not been thoroughly examined, various mechanisms can be conceived. An understanding of the specific mechanisms moves toward a more thorough understanding of the effect of depression on women's reproductive health and decisions, thus, better informing public health initiatives and policies. Figure 1 in Appendix B provides a schematic overview of various mechanisms that may explain the relationship between depression, contraceptive behaviors, and unintended or teenage pregnancy.

Depression and decision-making

Depression can alter the decision-making process in individuals, which may have a negative or positive influence on contraceptive method choice. Decision-making is a compound process which may be influenced by elements of decision maker's intrapersonal environment interact and elements of external world. When making a single decision, a decision maker's personal preferences and personality, emotional state at the time of decision making, the characteristics of the options available, and the amount of information available to the individual at the time of

decision-making act together influencing the individual to recognize and evaluate all the options available and produce the best possible outcome (Lerner, Li, Valdesolo, & Kassam, 2015). Hence, any change in one of these components may affect the decision being made.

Depression has been shown to negatively influence emotions and the regulation of emotions in individuals (Joormann & Vanderlind, 2014). Depressed individuals tend to engage more in thinking about their depressive symptoms and are preoccupied with the potential implications that these symptoms have on their lives. These are behaviors that perpetuate and exacerbate the depressed mood, producing negative thoughts in the depressed individual, which consequently can lead to increased dissatisfaction with life (Lewinsohn, Rohde, & Seeley, 1998; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Depressed individuals may, therefore, experience anhedonia together with a low sense of motivation. They may also have less sense of control over life events. Depression can also lead individuals to focus more on the negative affects while simultaneously diminishing positive affects, and to avoid taking risks compared to non-depressed individuals (Leahy, 2001; Raes, Smets, Nelis, & Schoofs, 2012; Werner-Seidler, Banks, Dunn, & Moulds, 2013). These emotional and behavioral changes, therefore, may influence the rational thinking, and decision-making process and the outcome of that process as a whole in depressed individuals.

Depression and its influence on decision-making process may also play a role in pregnancy intention. The low levels of self-efficacy and motivation for contraceptive use in depressed adolescents may influence their contraceptive

behaviors, such as contraceptive choice or continuation, and consequently teenage pregnancy (Carvajal et al., 2014). Furthermore, as mentioned previously, depression may lead to feelings of ambivalence about becoming pregnant especially among adolescent girls (Francis et al., 2015a).

Depression and contraceptive method choice

With respect to reproductive health decisions, when facing a decision about what contraceptive method to choose, compared to their non-depressed counterparts, depressed women may focus more on the negative side effects of contraceptive methods such as oral contraception or LARCs, may be less likely to perceive potential benefits from using these methods to prevent pregnancy, and consequently choose a less effective method of contraception (Garbers et al, 2010). In turn, these decisions could influence discontinuation of their contraceptive method and place depressed women at a higher risk for unintended pregnancy. Alternatively, however, the feeling of risk aversion and anhedonia about motherhood in depressed women may lead them to choose a more effective contraceptive method to avoid the risk of becoming pregnant in the future. Some studies have shown that women with more depressive symptoms are more likely to choose or use a more effective contraceptive method compared to women with less depressive symptoms (Callegari et al., 2014; Farr et al., 2011b; Francis et al., 2015b; Steinberg et al., 2013). However, it is unclear how depression impacts contraceptive choice among women seeking abortion services, who may experience a transient elevated level of depressive symptoms immediately before undergoing the abortion procedure, rather than a long-lasting period of elevated depressive symptoms.

Depression and contraceptive method continuation

Depression may also influence contraception continuation. Depressed individuals demonstrate a low sense of self-efficacy, viewing themselves as incapable and incompetent of performing a particular task or behavior to achieve an expected outcome (Bandura, 1977). Depression may also influence motivation, affecting an individual's ability to conduct and continue a behavior (Bolles, 1972). Furthermore, depressed individuals feel a low sense of predictability and a lowered sense of control over future events (Leahy, 2001). These factors together may—concurrently or independently from each other—interfere with depressed individuals' health behaviors, including contraceptive behaviors. Empirical studies have shown that depressed women are less likely to comply with their medication regimen compared to their non-depressed counterparts (e.g. DiMatteo et al., 2000). Therefore, when using a contraceptive method, depressed women may view themselves as incapable of using the contraceptive method or be less motivated to utilize the method and consequently discontinue contraception. In fact, compared to non-depressed women, depressed women are more likely to discontinue their contraceptive method over time (Hall et al., 2012; Westhoff et al., 1998a; Westhoff et al., 1998b; Zink et al., 2002). Depression may lead to feelings of ambivalence about pregnancy (Francis et al., 2015a), which, in turn, may result in contraception discontinuation.

Depression and unintended pregnancy/teenage pregnancy

The potential choice of less effective contraceptive methods and higher likelihood of contraception discontinuation place depressed women at a higher risk

for unintended pregnancy, or for adolescents, a teen pregnancy compared to non-depressed women. Figure 1 in Appendix B provides an overview of the mechanisms.

Covariates associated with contraceptive behaviors and teenage pregnancy

Sociodemographic characteristics

As mentioned previously, choice of contraceptive methods and the decision to continue a particular method, as well as rates of unintended and teenage pregnancies differ by women's sociodemographic characteristics such as race and ethnicity, age, material status, and socioeconomic status (Daniels et al., 2015; Dehlendorf et al., 2010; Hall et al., 2014; Hall et al., 2017; Peipert et al., 2011). Therefore, these variables will be controlled for in all three studies of this dissertation.

Pregnancy related characteristics

Number of previous abortions, parity, and feelings about becoming pregnant have also been shown to be associated with women's choice of contraceptive methods and continuation in reproductive health literature (Berlan, Mizraji, & Bonny, 2016; Garbers et al., 2010; Peipert et al., 2011; Steinberg et al., 2013) and therefore will be examined as covariates in the three studies in this dissertation.

Experience of past adversities

Women's experience of past adversities including childhood adversities, intimate partner violence, and experience of reproductive coercion have also been shown to be associated with women's depressive symptoms (Steinberg et al., 2016). Therefore, we will examine these variables in the first study of this dissertation.

Sexual behavior of women

Women's age at first sex as well as previous use of contraceptive methods have shown to be associated with contraceptive behaviors and teenage pregnancy (Hall et al., 2012; Hall et al., 2012; Hall et al., 2017). Therefore, these variables were examined in analyses using contraceptive method discontinuation and teenage pregnancy as outcomes.

Conclusion

Considering the negative impact of unintended pregnancy on maternal and child health and society, the debilitating effects of depression on the reproductive decision making of women, and the interrelatedness of contraceptive behaviors and unintended pregnancy, further investigation of the relationship between depression, and contraceptive behaviors and teenage pregnancy among women of reproductive age is warranted.

Therefore, the overall objective of this dissertation was to further investigating the relationship of depression with contraceptive behaviors, teen pregnancy, and unintended pregnancy. To do this, I first examined the independent association between depressive symptoms and contraceptive method choice. Second, I investigated the association between depressive symptoms and contraceptive continuation and unintended pregnancy. Third, I assessed the independent association between depression and teenage pregnancy. The specific aims and hypotheses of this dissertation include:

Aim 1: To examine the relationship between pre-abortion depressive symptoms and effectiveness level of contraceptive method choice after contraceptive counseling among women seeking abortion services.

Hypothesis 1: Women with higher pre-abortion depressive symptoms are more likely to choose a less effective contraceptive method after contraceptive counseling compared to women with lower depressive symptoms.

Aim 2: To examine the relationship between the experience of past and current depressive symptoms and contraception continuation and unintended pregnancy over 12 months among women seeking reproductive health services.

Hypothesis 2: Women experiencing past and current elevated depressive symptoms are more likely to discontinue their contraceptive method and experience an unintended pregnancy over 12 months than those with no depressive symptoms.

Aim 3: To examine whether the timing of depression onset relative to sexual debut is associated with an increased likelihood of experiencing first pregnancy among adolescent girls aged 13-18.

Hypothesis 3: Adolescent girls who have depression onset before the age at first sex have an increased likelihood of experience first pregnancy than girls with no depression onset.

Chapter 2: Literature Overview

This chapter provides a summary of studies examining the associations between depression/depressive symptoms and women's contraceptive behaviors, unintended pregnancy, and teenage pregnancy.

Depression and Contraception

The literature at the intersection of contraceptive behaviors and mental health has examined the bidirectional relationship between mental health and contraception. Most research had examined the effect of contraceptive methods (hormonal contraceptives in particular) on women's mental health (Moller, 1981). Research done in the 1970s when doses of hormones used in birth control were higher than now, found that consuming hormonal contraception was associated with depression in women (Kay et al., 1974). More recently, a study based in Denmark also found that compared to non-users, users of hormonal contraceptive methods were at an increased risk for subsequent antidepressant medication (Skovlund, Morch, Kessing, & Lidegaard, 2016). In contrast to these findings, many studies usually find no independent association (e.g. Duke, Sibbritt, & Young, 2007; Hall et al., 2015; O'Connell, Davis, & Kerns, 2007; Robinson, Dowell, Pedulla, & McCauley, 2004) or find that use of hormonal contraceptive methods to be associated with decreased levels of depressive symptoms (Keyes et al., 2013).

In contrast to examining the effects of contraception on depression, emerging research has investigated how experiencing depression may influence women's contraceptive behaviors (Hall et al., 2013a; Hall et al., 2013b; Hall et al., 2014; Hall

et al., 2015; Steinberg et al., 2013; Steinberg & Rubin, 2014; Takahashi et al., 2012). Specifically, some studies have empirically examined the association between depression and contraceptive choice (e.g., Garbers et al., 2010), depressive symptoms and method continuation (e.g. Hall, White, Rickert, Reame, & Westhoff, 2012), and depressive symptoms and method use and consistency (e.g., Hall et al., 2013a; Hall et al., 2013b).

Depression and choice of contraceptive methods

A few studies have investigated the association between depression and contraceptive method choice and they have contradictory findings. In a cross-sectional study of adult women seeking reproductive services in New York City, Garbers and colleagues found that women with depression had lower odds of choosing any modern contraceptive method including injection, patch, contraceptive sponge, diaphragm, emergency contraception, female condoms, IUD, implant, oral contraception, spermicide and condom, and tubal ligation) than women who did not have depression (Garbers et al., 2010). In contrast, Steinberg et al found that among women seeking abortions, those with severe depressive symptoms had higher odds of choosing more versus less effective contraceptive methods than women without severe depressive symptoms (Steinberg et al., 2013). Similarly, using a sample of minority adolescents 15-19 years old, attending a health center, Francis et al (2015) found that compared to girls with no elevated depressive symptoms, those with elevated depressive symptoms were more likely to select a LARC method than the depot injection. Finally, in a study of women's postpartum contraceptive choice no

association between perinatal depressive symptoms and the choice of contraceptive methods among postpartum women was found (Faisal-Cury et al, 2013).

Depression and contraceptive method continuation

The effect of depression on women's contraception discontinuation has been examined for specific contraceptive methods in four studies. The overall findings of the studies investigating this relationship indicate that women with elevated levels of depressive symptoms may be at a higher risk for discontinuation of contraceptive methods (Hall et al., 2012; Westhoff et al., 1998). Three of the studies measured depressive symptoms at baseline (Hall et al., 2012; Westhoff et al., 1998a; Westhoff et al., 1998b) and one study measured presence of depression retrospectively using medical records (Zink Shireman, Ho, & Buchanan, 2002). Specifically, in a study of young women (13-24 years old) and oral contraception, compared to less depressed women, women with more depressive symptoms at baseline were more likely to discontinue their method at 6 months' follow-up due to perceiving more weight gain than those who has less depressive symptoms (Hall et al., 2012). Furthermore, Westhoff et al. (1998) found that adult women who continued using implant for 6 months had lower baseline depressive symptoms scores than those with discontinued their method at 6 months. Similar result was found for depot shot at 12 months (Westhoff et al., 1998a; Westhoff et al., 1998b). Finally, in the retrospective examination of billing statements of adolescent girls 12-19 years old, Zink et al found that presence of mood disorders including depression was associated with 12-month contraception discontinuation for prescription contraception (Zink et al., 2002).

Depression and other contraceptive behaviors

Depression has also been shown to be associated with contraceptive non-use and inconsistent use (Berenson, Breitkopf, & Wu, 2003; Hall et al., 2014; Hall et al., 2013a; Morrison et al., 2016). Examining the weekly diaries of women aged 18-20, Hall and colleagues found that in a period of 12 months, women with depression had 47% reduced odds of consistent use of contraceptive methods compared to women with no depression (Hall et al., 2013b). Also, in a cross-sectional examination of AddHealth participants, Morrison and colleagues found a significant association between more depressive symptoms and 91% increased odds of inconsistent contraceptive use in 12-month among women 18-24 years old (Morrison et al., 2016).

Furthermore, depressed women may be more likely to be involved in relationships with controlling partners and have less reproductive freedom and therefore more likely to be subjected to reproductive coercion (Azevedo, Araujo, Valongueiro, & Ludermit, 2013; Miller et al., 2010; Miller et al., 2014). Reproductive coercion may place depressed women at increased risk of not using contraception or using contraceptive methods incorrectly and inconsistently, leading to increased rates of unintended pregnancy.

In addition to the negative effect of depression on contraceptive behaviors, depressive symptoms are shown to be associated with other related reproductive behaviors, experiences, or outcomes such as substance use during the last sexual intercourse, earlier coitarche, non-consensual sex, experience of intimate partner violence, and higher rates of sexually transmitted infections (Lehrer, Shrier, Gortmaker, & Buka, 2006; Lehrer, Buka, Gortmaker, & Shrier, 2006). The negative

effect of depression on contraceptive and other related reproductive behaviors may place women at a higher risk for unintended pregnancies during adolescents and adulthood.

Depression and Unintended Pregnancy

Previous research has shown an association between elevated levels of depressive symptoms or depression and unintended pregnancy in women of reproductive age (DiClemente et al., 2001; Hall et al., 2014; Hall et al., 2017; Nelson & Lepore, 2013; Takahashi et al., 2011). Using data from women aged 18-20 with a strong desire to avoid pregnancy in the subsequent year, Hall and colleagues found that women with co-occurring depressive and stress symptoms at baseline were at 2.3 times higher risk of pregnancy within a year than women with no symptoms (Hall et al., 2014). Similarly, using an urban sample of pregnant women 14-40 years old, Nelson and Lepore (2013), found that women with more depressive symptoms had 2.14 times higher odds of reporting their pregnancies as unintended than those with less depressive symptoms. Takahashi et al also found that a history of depression was associated with mistimed pregnancy among a group of adult Japanese women (Takahashi et al., 2012).

Depression and Teenage Pregnancy

As mentioned in the previous chapter, 16% of girls aged 13-18 years old have already experienced depression during their lifetime (National Comorbidity Survey, Appendix Table 2, N.D.). Additionally, according to the National Comorbidity Survey, 23% of women 15-16 years old have already experienced depression

sometime in their lifetime (Kessler & Walters, 1998). Depression has been shown to influence feelings of pregnancy ambivalence, especially among adolescent girls (Francis et al., 2015a). Francis and colleagues found that among minority adolescent girls ages 15-18 years old in the United States, living in an urban setting, girls with more depressive symptoms had higher odds of pregnancy ambivalence compared to those with no depressive symptoms (Francis et al., 2015a). In another study, using data from 522 unmarried black women aged 14-18 years old, DiClemente and colleagues found that those experiencing psychological distress at baseline were at a higher risk for pregnancy at 6 months follow up compared to those with no psychological distress (DiClemente et al., 2001). Similarly, using AddHealth data, Hall et al., that moderate/severe depressive symptoms increased the risk of unintended first pregnancy among adolescent girls (Hall et al., 2017). While pregnancy intentions among teens may vary, the majority of teenage pregnancies in the US are unintended (Finer & Zolna, 2016) and lower rates of compliance to contraceptive methods among adolescents with mental health conditions can place them at a higher risk for unintended pregnancy (Zink et al., 2002).

Summary

The reproductive health literature on the association between depression and contraceptive behaviors and teenage pregnancy carries several limitations. First, there are only a few studies that measure the association between depression and the effectiveness of contraceptive method choice at the healthcare provider setting, and among these studies the findings are inconsistent (Francis, Presser, Malbon, Braun-Courville, & Linares, 2015b; Faisal-Cury, Menezes, & Huang, 2013; Garber et al.,

2010; Steinberg et al., 2013). This inconsistency in findings may be attributable to differences in operationalization of the contraceptive method choice and sample characteristics in each study. Second, studies examining the association between depression and contraception continuation use a single measure of depressive symptoms usually at baseline, and the effect of multiple measures of depression over time on contraceptive continuation and pregnancy is missing from the literature (Hall et al., 2013a). Although the findings from these studies uniformly confirm a positive association between elevated levels of depressive symptoms and higher rates of discontinuation over time, it is still unclear whether persistence of depressive symptoms over time influences women's contraception continuation rates. Using multiple measures of depression can provide us with a better understanding of the nature of depressive mood and whether what is being picked up is a transient versus a more persistent depression and how each can predict women's contraceptive method continuation. Finally, despite the high prevalence of lifetime depression in adolescent girls, there is no evidence on whether the timing of depression onset can influence the risk of pregnancy. The next three chapters include studies to address these problems.

Chapter 3: Study One

Title: The effects of pre-abortion depressive symptoms on post-abortion contraceptive method choice among women seeking abortion services
Forthcoming; Vafai, Y., Steinberg, J. R. (2018). The effects of pre-abortion depressive symptoms on post-abortion contraceptive method choice among women seeking abortion services. *Contraception*, 97(4), 335-340.

Abstract

Objective: Ninety-five percent of abortions are due to an unintended pregnancy and compared to women seeking contraceptive services, women seeking abortion services are at an increased risk for experiencing a subsequent unintended pregnancy. Some women experience high levels of mental distress before an abortion, which may influence their contraceptive decisions in the abortion setting. **Method:** Using multinomial logistic regression models and a sample of 345 adult women seeking abortions due to an unintended pregnancy at three different community health clinics in northern California, we examined the relationship between pre-abortion depressive symptoms and effectiveness level of contraceptive method chosen (low, moderately, or highly effective) after contraceptive counseling. **Results:** After adjusting for women's race/ethnicity, marital status, education, age, abortion trimester, abortion type, experiences of IPV and reproductive coercion in the past 6 months, adversities experienced during childhood, previous number of abortions and children, and future pregnancy desires, women with more depressive symptoms had 1.054 times higher odds of choosing a low effective than a moderately effective contraceptive method

(95% CI: 1.008-1.102, p=0.020). Women with more depressive symptoms also had 1.045 times higher odds of choosing a low effective than a highly effective contraceptive method, however the differences were only marginally significant (95% CI: 0.998-1.093, p=0.060). **Conclusion:** More pre-abortion depressive symptoms were associated with choosing a less effective contraceptive method placing women at a higher risk for subsequent unintended pregnancies. **Implications:** Reproductive health care providers should consider the impact of women's psychological symptoms on their contraceptive decision-making.

Introduction

Ninety-five percent of abortions are the result of an unintended pregnancy (Finer & Zolna, 2011). Women seeking abortions are at a higher risk for experiencing a subsequent unintended pregnancy than women seeking contraceptive services (Upadhyay et al., 2012). While 96% of clinics offering abortion services also offer post-abortion contraception services (Kavanaugh, Jones, & Finer, 2010), there is still a dearth of evidence on what factors influence women's contraceptive choices in an abortion care setting. A broader understanding of what factors are associated with women's choice of more versus less effective contraceptive methods may better enable reproductive health and abortion providers to help women prevent subsequent unintended pregnancies.

Previous studies have found that factors such as younger age, lower education level, experience of intimate partner violence, having a desire for future pregnancy, no history of abortion, and not wanting contraceptive information during contraceptive counseling are associated with women choosing less versus more effective contraceptive methods in abortion care settings (Moslin & Roachat, 2011; Steinauer et al., 2015; Taylor, Connolly, Ingles, Watson, & Segall-Gutierrez, 2014). Another factor that has been shown to be associated with women's contraceptive choices after an abortion is pre-abortion psychological health, particularly depressive symptoms (Steinberg et al., 2013). This study extends Steinberg et al.'s (2013) study, which sampled women from one urban hospital abortion clinic providing patient-centered contraceptive counseling, to examine the extent to which pre-abortion

psychological health is associated with the effectiveness level of contraception chosen among women seeking abortions at three community reproductive health clinics.

Only a handful of studies have examined the relationship between depressive symptoms or depression and the effectiveness of the contraceptive method chosen or used among reproductive-aged women (Callegari et al., 2014; Faisal-Curry, Menezes, & Huang, 2013; Farr, Curtis, Robbins, Zapata, & Dietz, 2011; Francis et al., 2015b; Garbers et al., 2010; Hall, Moreau, Trussell, & Barber, 2013a; Steinberg et al., 2013). Findings from these studies were inconsistent and may have varied due to selection of participants from different reproductive health settings, or variation in operationalization of the outcome. Some studies found that elevated depressive symptoms were associated with choosing or using a less effective contraceptive method (Farr et al., 2011; Garbers et al., 2010; Hall et al., 2013a), while others found that more depressive symptoms were associated with choosing or using a more effective contraceptive method (Callegari et al., 2014; Francis et al., 2015b; Steinberg et al., 2013). Finally, others have found no association between more depressive symptoms and the effectiveness of contraceptive methods chosen or being used (Faisal-Curry et al., 2013; Farr et al., 2011). Only one study has focused on the association between depressive symptoms and the effectiveness of contraceptive method choice in an abortion setting (Steinberg et al., 2013). Women seeking abortions represent a critical population for addressing factors that influence contraceptive decision-making. Given the inconsistency in findings of these studies and the little research on the effect of women's pre-abortion mental health symptoms on contraceptive method choice, further examination of the association between

women's pre-abortion depressive symptoms and effectiveness level of contraceptive method chosen among women seeking abortions is warranted.

The current study aims to add to antecedent literature: (1) factors that influence women's contraceptive choice in the abortion care setting, and (2) the extent to which depression influences the effectiveness level of contraception that women select to use. Findings from this study may also be used to inform clinical practice. Research has consistently shown that women seeking abortions experience higher levels of depressive symptoms just before compared to just after an abortion (Cozzarelli, 1993; Major et al., 2000). If more pre-abortion depressive symptoms are associated with the effectiveness levels of women's contraceptive choices, then those involved in contraceptive counseling among women seeking abortions should be aware of this.

In this paper, we build on Steinberg et al. (2013), by testing the association between pre-abortion depressive symptoms and the effectiveness levels of contraceptive methods women chose to use at three different community reproductive health clinics. We included the same covariates as Steinberg et al. (2013) as well as covariates that have recently been found to be associated with pre-abortion depressive symptoms (Steinberg, Tschann, Furgerson, & Harper, 2016) to examine whether pre-abortion depressive symptoms are independently associated with effectiveness level of contraceptive method selected.

Material and Methods

Participants

Women 18 years of age or older seeking surgical or medication abortions not due to fetal anomaly or a medical condition at three community reproductive health centers in Northern California between July 2012 and February 2013 were recruited to participate in a study on decisions women make about contraception following an abortion.

Procedure

At each recruitment site, the self-administered questionnaire was answered at two time points. Women answered Part 1 of the questionnaire in waiting rooms before contraceptive counseling and Part 2 was completed after contraceptive counseling before women left the clinic. Part 1 of the questionnaire assessed women's socio-demographics, current mental health, pregnancy history, recent and past adverse experiences, relationship characteristics, contraceptive attitudes, beliefs, and self-efficacy, future pregnancy desires, and past contraceptive use. The question relevant to this study on Part 2 was the question assessing the main contraceptive method women planned to use after their abortion. We used this variable because some women at these sites did not receive their contraceptive method on the same day as their abortion and therefore we did not have information on what they actually used.

Measures

Outcome – Post-abortion Method Choice Effectiveness Level

The effectiveness level of participants' main contraceptive method choice after abortion was defined based on a question in Part 2 answered after contraceptive counseling. Women were asked: "What is the **main** method of pregnancy prevention, if any, you plan to use in the next 6 months to prevent you from getting pregnant? (Please choose only one)". The response options included "the pill, the patch (Ortho Evra), the vaginal ring (Nuva Ring), the shot (Depo-Provera, injectable), implant (Implanon), Mirena (hormone IUD), ParaGard (copper IUD), condom or rubber (for partner), diaphragm, spermicide, emergency contraception (Plan B, Next Choice, Morning After pill), pulling out or withdrawal, rhythm method or natural family planning, abstinence (no heterosexual intercourse), tubal ligation (tying your tubes), I do not plan to use any method, and other, please specify". The effectiveness level of the intended contraceptive method choice post-abortion was categorized into three categories of low, moderately, and highly effective contraceptive methods based on the methods' typical use failure rates (Trussell, 2011). Based on participants answers to this question, methods with typical use failure rates greater than 10% were classified as low effective (no methods, abstinence, and condom), those with failure rates between 1 to 10% were classified as moderately effective (the pill, patch, vaginal ring, and shot), and those with failure rates less than 1% were classified as highly effective (implant, IUD, and male and female sterilization).

Main predictor – Depression

Participants' depressive symptoms were assessed with the Center for Epidemiologic Studies Depression (CES-D) Scale (Radloff, 1977) on the first part of the questionnaire. Sample items include "I was bothered by things that usually don't bother me", "I did not feel like eating", and "My appetite was poor". The scale assessed how often (0= not at all to 3= extremely) women experienced each item in the past 2 weeks. Similar to Steinberg et al. (2013), we created both a continuous measure of depressive symptoms score and a dichotomous measure to categorize those with elevated depressive symptoms. The continuous measure was the sum of the 20 items. Women could be missing on up to 5 items in which case mean imputation was used to create a sum on 20 items for the missing items (n=21). To create the dichotomous measure of the elevated depressive symptoms, we coded women with depressive symptoms scores at or above one standard deviation above the mean (1 SD above the mean was 35.21) as experiencing elevated depressive symptoms, while women with scores below 35.21 were coded as not experiencing elevated depressive symptoms. This cut-off was chosen over the other common CES-D cut offs of 16 and 20 because depressive symptoms have been shown to be elevated just before an abortion, compared to just after the procedure (Cozzarelli, 1993; Major et al., 2000). Using this method, 17.1% of the participants were categorized as experiencing elevated depressive symptoms.

Covariates

Based on the literature, we included the following covariates due to their established associations with either contraceptive choice effectiveness level or

depressive symptoms: socio-demographic characteristics including race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, other), marital status (never married, married, widowed/separated/divorced, cohabiting), education (less than high school, high school graduate, some college, college degree or higher), and age; pregnancy characteristics included abortion trimester (second vs. first), type of abortion (surgical vs. medication); past adversities included whether or not the woman experienced intimate partner violence (yes vs. no) and reproductive coercion (yes vs. no) in the past 6 months, and number of childhood adversities; relationship context included number of sexual partners in the past six months (one vs. multiple partners); previous pregnancies characteristics included number of previous children (none vs. one or more), and number of previous abortions (none vs. one or more); and future pregnancy desires included the importance of avoiding pregnancy in the next year, and desire to become pregnant in the future (less than 3 years vs. 3 years or more or never).

Analyses

We first examined the bivariate relationships between depressive symptoms, contraceptive method choice effectiveness, and all study covariates. Correlations were used when two variables were continuous, chi square tests when two variables were categorical, and Student's t-test and one-way ANOVA F-tests when one variable was categorical and the other continuous to examine their relationships. If the general ANOVA F-test was significant with $p < 0.05$ and there were three or more categories for the categorical variable, we performed Tukey's Honestly Significant Differences test to detect differences between specific categories. We then conducted

multinomial logistic regression analysis for the three-level categorical variable of post-abortion contraceptive method choice effectiveness. First, in Model 1, we examined the unadjusted multinomial regression models in which the three-level effectiveness coding (low, moderately, and highly effective) was regressed on the *continuous* measure of depressive symptoms. Second, in Model 2 we examined the adjusted multinomial regression model using the same covariates as those used in Steinberg et al. (2013)—age, race/ethnicity, marital status, education level, trimester of abortion, previous number of children, previous number of abortions, and the importance of avoiding pregnancy in the next year. Finally, in Model 3 we examined the adjusted multinomial model using all covariates in Model 2 and type of abortion, any experience of IPV in the past 6 months, any experience of reproductive coercion in the past 6 months, number of childhood adversities (0 to 8), number of sexual partners in the past 6 months (2 or more vs. 1), and the desire to become pregnant in three or more years or never, based on findings from Steinberg et al. (2016). We then repeated the procedure using the *dichotomous* measure of elevated depressive symptoms. All analyses were completed using IBM SPSS version 23.

Results

Four hundred and eighty-seven women 18 years or older presenting for abortion due to an unintended pregnancy at three community reproductive health centers filled out Part 1 of the survey. We excluded 38 women because it was unclear whether they followed through with the abortion procedure (n=10), their responses were questionable (n=1), they were missing on most items in Part 1 (n=16), or they were missing on the CES-D depression measure (n=11). Of the 449 women

remaining, we excluded women who were missing on all or most of the items in Part 2 of the survey (n=36), where the question on contraceptive choice after contraceptive counseling was asked. Finally, from the 413 women remaining we excluded those that were missing on the outcome variable (n=12) and those that were missing on any of the covariates (n=56), leaving 345 women in the analytic sample. There were no statistically significant differences between those 56 women missing on the covariates and the 345 women that were not on both the effectiveness level of post-abortion contraceptive method choice ($p=0.993$) and women's depressive symptom scores ($p=0.255$).

Descriptive information of women's demographic characteristics, pregnancy characteristics, experiences of past adversities, relationship characteristics, characteristics of previous pregnancies, and desire for future pregnancies are presented in Table 1-1. The majority of women identified as non-white (72.8%), were never married (52.8%), and had a household income at or below \$10,000 per year (61%). Women's average age was 26 years old (ranging from 18 to 48 years) and 66% of women reported having some college or higher education. The majority of women were having a first trimester (93%) abortion and a surgical (68%) abortion. Most women reported not experiencing any IPV (66%) or reproductive coercion (84%), and the majority (76%) reported having only one sexual partner in the 6 months prior to the study respectively. Furthermore, women in the sample reported experiencing an average of 2.7 (SD =2.1) adversities during childhood. Fifty-three percent of the women in the sample were seeking abortion services for the first time and about 51% reported having at least one child. The majority of women (74%)

reported a strong desire to avoid becoming pregnant in the following year and most (66%) reported a desire to become pregnant in more than three years or never. Thirty-five percent of women selected contraceptive pills and 30% chose IUDs. Thirty-eight percent of women in the sample reported choosing a highly effective, 55% reported choosing a moderately effective, and 7% reported choosing a low effective contraceptive method after contraceptive counseling. The mean depressive symptoms score was 23.2 (SD =12.0) ranging from 0 to 57.

Table 1-2 presents the bivariate relationships between women's depressive symptoms and the study covariates. There were significant differences in women's mean depressive symptoms scores with respect to covariates including women's age, experience of past adversities, relationship context, and previous pregnancy characteristics. Women who were younger ($p=0.01$), had experienced any IPV ($p<0.001$) in the past 6 months, had experienced any reproductive coercion ($p=0.001$) in the past 6 months, had experienced more adversities during childhood ($p<0.001$), had multiple sexual partners in the past 6 months ($p=0.055$), and had one or more prior children ($p=0.001$) had higher (or marginally higher in the case of multiple sexual partners) mean depressive symptoms scores.

Table 1-3 presents the bivariate relationship between the study covariates and women's contraceptive choice effectiveness level. There were significant relationships between women's contraceptive choice effectiveness on different levels of covariates including current pregnancy characteristics, experience of past adversities, relationship context, previous pregnancy characteristics, and desire for future pregnancies. Women who had a surgical abortion ($p=0.024$), a second trimester

abortion ($p=0.045$), one or more prior children ($p=0.019$), experienced any IPV in the past 6 months ($p=0.045$), a higher number of adversities during childhood ($p=0.022$), reported having more than one sexual partner in the 6 months prior to the study ($p=0.003$), did not say it was very important to prevent pregnancy in the next year ($p=0.039$) and reported having the desire to become pregnant in less than three years ($p=0.017$) were more likely to choose a low effective method than a moderate *or* a highly effective method of contraception.

We examined the association between women's depressive symptoms and the effectiveness level of contraceptive method selected in unadjusted and adjusted multinomial regression models (Table 1-4). In the unadjusted model (Model 1a), using the continuous depressive symptoms, we found that with each unit increase in depression score (or as depressive symptoms increased), women had significantly higher odds of choosing a low effective versus a moderately effective (OR = 1.051, 95% CI: 1.016-1.087, $p=0.004$) or a highly effective contraceptive method (OR = 1.046, 95% CI: 1.011-1.083, $p=0.011$) respectively. However, there was no significant association between depressive symptoms and choosing a moderately effective versus a highly effective contraceptive method (OR = 0.996, 95% CI: 0.977-1.015, $p=0.656$). Similarly, using the dichotomous measure of elevated depressive symptoms, in the unadjusted model (Model 1b), women with elevated depressive symptoms had higher odds of choosing a low effective versus a moderately effective (OR = 1.896, 95% CI: 0.732-4.913, $p=0.188$) and a highly effective contraceptive method (OR = 2.178, 95% CI: 0.806-5.886, $p=0.125$), compared to those without

elevated depressive symptoms, although these findings were not statistically significant.

In the adjusted models, we first adjusted the regression model for all covariates used in Steinberg et al. (2013), (Table 1-4, Model 2a and Model 2b). In Model 2a, with each increase in depression score (or as depressive symptoms increased), women had higher odds of choosing a low effective than a moderately effective (aOR = 1.063, 95% CI: 1.022-1.105, p=0.002) and a highly effective contraceptive method (aOR = 1.051, 95% CI: 1.010-1.093, p=0.014). Using the dichotomous measure of elevated depressive symptoms (Model 2b), compared to those with no elevated depressive symptoms, women with elevated depressive symptoms had higher odds of choosing a low effective than a moderately effective (aOR = 2.152, 95% CI: 0.772-6.000, p=0.143) and a highly effective contraceptive method (aOR = 2.235, 95% CI: 0.764-6.534, p=0.142). However, these associations were not statistically significant (p>0.1).

Next, we conducted models adjusted for all covariates in Model 2 plus type of abortion, experience of IPV in the past 6 months, experience of reproductive coercion in the past 6 months, number of childhood adversities, number of sexual partners in the past 6 months, and the desire to become pregnant in three or more years or never. After adjusting for all covariates in the study (Table 1-4, Model 3a), compared to women with fewer depressive symptoms, those with more depressive symptoms had higher odds of choosing a low effective than a moderately effective contraceptive method (aOR = 1.054, 95% CI: 1.008-1.102, p=0.020) and marginally higher odds of choosing a low versus a highly effective method (aOR = 1.045, 95% CI: 0.998-1.093,

p=0.060). This meant that after adjusting for all covariates in Model 3a, one unit increase in women's depressive symptoms score was associated with 5.4% higher odds of choosing a low effective than a moderately effective and 4.5% higher odds of choosing a low than a highly effective contraceptive method. Similarly, in the adjusted models using dichotomous measure of elevated depressive symptoms, (Model 3b), the odds of choosing a low versus a moderately effective (aOR = 1.679, 95% CI: 0.548-5.143, p=0.364) and highly effective (aOR = 1.844, 95% CI: 0.572-5.945, p= 0.305) contraceptive methods remained higher for women with elevated depressive symptoms, though the associations were not statistically significant. There were no significant associations between more depressive symptoms or elevated depressive symptoms and choosing a moderately effective than a highly effective contraceptive method in the adjusted models (p>0.1).

We also ran the regression models using the CES-D cut-off of 20 for elevated depressive symptoms (Andersen, Malmgren, Carter, & Patrick, 1994) and we found comparable but statistically significant results to those when using the higher cut-off score of 35.21. In the unadjusted model (Model 1b), women with elevated depressive symptoms had higher odds of choosing a low effective than a moderately (OR = 4.620, 95% CI: 1.527-13.975, p=0.007) and a highly effective (OR = 3.522, 95% CI: 1.144, 10.843, p=0.028) contraceptive method compared to women with no elevated depressive symptoms using the cut off of 20. Similarly, in Model 2b, compared to those with no elevated depressive symptoms, women with elevated depressive symptoms were more likely to choose a low effective than a moderately (aOR = 5.987, 95% CI: 1.792-20.008, p=0.004) and a highly effective (aOR = 3.835, 95% CI:

1.127-13.044, $p=0.031$) contraceptive method. Furthermore, in the fully adjusted model (Model 3b), compared to women with no elevated depressive symptoms, those with elevated depressive symptoms had higher odds of choosing a low effective versus a moderately effective (aOR = 3.999, 95% CI: 1.149-13.917, $p=0.029$) contraceptive method. The odds of choosing a low versus a highly effective (aOR = 2.634, 95% CI: 0.733-9.468, $p=0.138$) contraceptive method was not statistically significant, but in the same direction compared to when using the other cut-off value of 35.21.

Table 1-5 presents the adjusted multinomial regression model (Model 3a) for the continuous measure of depressive symptoms. Having a second trimester abortion was significantly associated with choosing a low effective versus a moderately effective contraceptive method (aOR = 0.192, 95% CI: 0.040-0.928, $p=0.040$). Similarly, having multiple sexual partners in the past 6 months was significantly associated with higher odds of choosing a low effective than a moderately effective (aOR = 2.866, 95% CI: 1.050-7.824, $p=0.040$) or a highly effective (aOR = 3.308, 95% CI: 1.166-9.389, $p=0.025$) contraceptive method. Furthermore, the only factors significantly associated with selecting a moderately versus a highly effective contraceptive method post-abortion were having a surgical abortion (aOR = 0.526, 95% CI: 0.308-0.988, $p=0.019$) and having previous children (aOR = 0.535, 95% CI: 0.296, 0.967, $p=0.038$).

Discussion

The purpose of this study was to investigate the independent relationship between women's depressive symptoms scores before abortion and the effectiveness

levels of contraceptive method chosen after contraceptive counseling among women seeking abortion services at multiple community reproductive health centers in Northern California. After controlling for all study covariates, a one-unit increase in pre-abortion depressive symptoms was associated with 5.4% higher odds of choosing a low effective versus a moderately effective contraceptive method. This means that if the depressive symptoms score for two women were 10 and 30 respectively, the latter woman would have a 176% increased odds of choosing a low versus a moderately effective contraceptive method post-abortion. Similarly, a one-unit increase in women's depressive symptoms was associated with 4.1% increased odds of selecting a low effective than a highly effective contraceptive method post-abortion, though this was only marginally significant in the fully adjusted model. Furthermore, we found similar odds ratios when comparing Model 1 (unadjusted), Model 2 (adjusted for variables used in Steinberg et al.'s (2013) study), and Model 3 (the fully adjusted model), except that there was only a marginally significant association between more depressive symptoms and choosing low versus highly effective methods in Model 3.

While we were unable to test the mechanism by which more depressive symptoms may have led to this effect, it is possible that since more depressive symptoms prompt more negative emotions, a negative cognitive framework, and a reduced sense of motivation and control (Joormann & Vanderlind, 2014; Leahy, 2001; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008; Raes, Smets, Nelis, & Schoofs, 2012; Werner-Seidler, Banks, Dunn, & Moulds, 2013), more depressive symptoms may have led women to think more negatively about the side effects of

moderately or highly effective methods, or lack motivation for choosing more effective contraceptive methods. Past research has found that among women using oral contraception, those with more depressive symptoms are more likely to perceive side effects, such as gaining more weight and worsening of mood, and to stop using the method (Hall, White, Rickert, Reame, & Westoff, 2012).

Our findings are consistent with some previous studies that found women with more psychological distress or depressive symptoms are more likely to choose or use less effective contraceptive methods (DiClemente et al., 2001; Farr et al., 2011; Garbers et al., 2010, Hall et al., 2013). Our findings, however, are in contrast to other studies, which found that more depressive symptoms were associated with choosing or using more effective contraceptive methods (Callegari et al., 2014; Francis et al., 2015b; Steinberg et al., 2013), or found no association between depressive symptoms and effectiveness levels of contraceptive method being used (Faisal-Cury, Menezes, & Huang, 2013; Farr et al., 2011). The inconsistencies in findings could be attributable to differences in operationalizing the outcome in different studies (Callegari et al., 2014; Francis et al., 2015b). For instance Francis et al., 2015 defined contraceptive method choice as short acting (pill, patch, ring, depo injections) vs. long acting (IUD) and did not include condoms and implants (Francis et al., 2015b). Furthermore differences in the contraceptive counseling offered at different reproductive health settings, may have given rise to differences in findings.

Although the current study is similar to Steinberg et al. (2013) study in that both used samples of women with similar sociodemographic characteristics presenting for abortions, both coded the outcome in the same manner, and both used

similar covariates, there are some differences that may explain the inconsistency in findings between the two studies. In our sample, more than 90% of the women were seeking first trimester abortions compared to 40% in Steinberg et al. (2013). Women seeking second trimester abortions may experience more psychological distress before their abortion compared to women seeking first trimester abortions, which may consequently affect their contraceptive method choice differently compared to those than those having first trimester abortions. Therefore, future research should focus on the interaction between trimester of abortion and depressive symptoms on contraceptive method effectiveness level selected.

Alternatively, the delivery of contraceptive counseling at clinics in our study may have been different from that in the Steinberg et al. (2013) study. The proportions of women choosing highly, moderately, and low effective contraceptive methods after contraceptive counseling in our sample (38%, 55%, and 7% respectively) were somewhat different from those in Steinberg et al., (2013; 42%, 43%, and 15% respectively). Delivery of contraceptive counseling (or other aspects of the abortion care visit) may have interacted with women's depressive symptoms to influence women's post-abortion contraceptive choices. To better inform the research on depressive symptoms' influence on contraceptive choice in an abortion setting, future research should further explore this. That is, are there certain contraceptive counseling strategies that can help women with more depressive symptoms choose more versus less effective contraceptive methods to best protect them from unintended pregnancy?

Another difference between the current study and Steinberg et al. (2013) worth mentioning is that in the current study, we measured contraceptive method choice effectiveness after contraceptive counseling by asking women what contraceptive method they *planned* to use in the next 6 months. We used this question because at our study sites, many women (62%) did not receive their contraceptive method on the same day they received their contraceptive counseling or abortion procedure. This was different from Steinberg et al. (2013) study in which contraceptive method choice after contraceptive counseling was measured by asking women what contraceptive method they were leaving the clinic with.

Furthermore, women seeking abortion services are a unique population as they may experience transient high levels of emotional distress immediately before going through the abortion procedure, rather than long-lasting periods of elevated depressive symptoms. Indeed, prior research has found that women's distress decreases from just before to just after an abortion (Bradshaw & Slade, 2003; Cozzerelli, 1993; Lowensein et al., 2006; Major et al., 2000). Therefore, to better understand the relationship between depression and contraceptive choice, future research should examine the effect of a more chronic clinical depression versus transient depressive symptoms on contraceptive behaviors.

In addition to depressive symptoms, having multiple sexual partners in the 6 months prior to the study was an independent predictor of women's contraceptive method choice. Women who reported having more than one sexual partner in the past 6 months were more likely to choose a low than a moderately or a highly effective contraceptive method. We also found that despite their significant associations with

contraceptive choice and depressive symptoms in the bivariate analyses, experiencing adversities during childhood and experiencing intimate partner violence in the 6 month prior to the study were not significantly associated with effectiveness level of contraceptive method selected in the adjusted multinomial logistic regression models. Considering childhood adversities and intimate partner violence have been shown to be predictors of both depression and contraceptive method non-use and unintended pregnancy (Pallitto & O'Campo, 2004; Williams, Larsen, & McCloskey, 2008), depressive symptoms may mediate the relationship between these adversities and contraceptive behaviors.

The current study has limitations that may influence the interpretation of these findings. First, even though depressive symptoms were assessed in the abortion care visit before the contraceptive choice was made, due to the cross-sectional design of the current study the causal nature of the association between women's depressive symptoms and contraceptive choice cannot be determined with certainty. Second, as mentioned above, it is ambiguous whether we are measuring transient distress or tapping the construct of depression given that previous research has found women's depressive, anxiety, and stress symptoms are elevated immediately before compared to immediately after an abortion (Cozzarelli, 1993; Lowenstein et al., 2006; Major et al., 2000). If we had information on women's mental health history and their depressive symptoms after the procedure, we would be able to shed some light on this matter. Finally, the convenient sample may limit the generalizability of our findings; however, the demographic characteristics of the women in our sample are similar to those identified in population-level abortion studies in terms of their age, income,

marital status, and trimester of abortion (Jatlaoui et al., 2013; Jones & Finer, 2012; Jones & Kavanaugh, 2011).

These findings contribute to the research on what influences contraceptive choice in the abortion care setting as well as research on the role of depression in contraceptive behaviors. Together with Steinberg et al's (2013), these findings cast doubt on the notion that depressive symptoms uniformly influence women's reproductive decisions and behaviors. Therefore, future research should explore possible moderating factors—in this case contraceptive counseling practices—that may interact with depressive symptoms to influence effectiveness levels of contraceptive method choice after abortion procedure.

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Tables

Table 1-1. Descriptive characteristics of the of the sample (N=345)

<i>Variables</i>	<i>% (N) or Mean (SD & Range)</i>
<i>Demographic Characteristics</i>	
Race and Ethnicity	
White, Non-Hispanic	27.2 (94)
Black, Non-Hispanic	20.3 (70)
Hispanic	28.4 (98)
Other	24.1 (83)
Education	
Less than High School	10.7 (37)
High School	23.5 (81)
Some College	43.8 (151)
College Graduate or More	22.0 (76)
Household Income	
\$10,000 or Less	60.6 (209)
\$10,001 to 49,999	27.8 (96)
\$50,000 or More	5.8 (20)
Missing	5.8 (20)
Marital Status	
Married	11.0 (38)
Never Married	52.8 (182)
Widowed, Separated, or Divorces	9.6 (33)
Cohabiting	26.7 (92)
Age	26.0 (6.0, 18-48)
<i>Pregnancy Characteristics</i>	
Abortion Trimester	
First	93.0 (321)
Second	7.0 (24)
Abortion Type	
Surgical	68.4 (236)
Medication	31.6 (109)
<i>Past Adversities</i>	
Intimate Partner Violence in the Past 6 Months	
Yes	33.9 (117)
No	66.1 (228)
Reproductive Coercion in the Past 6 Months	
Yes	16.2 (52)
No	83.8 (289)
Number of Childhood Adversities	2.7 (2.1, 0-8)

<i>Relationship Context</i>	
Number of Sexual Partners in the Past 6 Months	
One Partner	75.7 (261)
Multiple Partners	24.3 (84)
<i>Previous Pregnancies Characteristics</i>	
Prior Abortions	
None	53.3 (184)
One or More	46.7 (161)
Prior Children	
None	49.0 (169)
One or More	51.0 (176)
<i>Future Pregnancy Desires</i>	
Very Important to Prevent Pregnancy in the Next Year	
Yes	74.5 (257)
No	25.5 (88)
Desire to Become Pregnant in 3 Years or More or Never	
Yes	66.4 (229)
No	33.6 (116)
Post Counseling Contraceptive Method Choice	
No Method	0.6 (2)
Abstinence	1.4 (5)
Condoms	5.2 (18)
Birth Control Pills	34.8 (120)
Patch	3.2 (11)
Ring	4.6 (16)
Shot	11.9 (41)
IUD	29.9 (103)
Tubal Ligation	1.2 (4)
Vasectomy	0.6 (2)
Implant	6.7 (23)
Post Counseling Contraceptive Choice Effectiveness	
High	38.3 (132)
Moderate	54.5 (188)
Low	7.2 (25)
Depression Score	
Below 35	82.9 (286)
At or above 35	17.1 (59)
Depressive Symptoms	23.2 (12.0, 0-57)

Table 1-2. Bivariate relationship between depressive symptoms and the covariates (N=345)

<i>Variables</i>	
<i>Demographic Characteristics</i>	<i>Mean Depression Score (SD)</i>
Race and Ethnicity	
White, Non-Hispanic	21.9 (10.9)
Black, Non-Hispanic	23.3 (12.4)
Hispanic	24.2 (12.8)
Other	23.5 (11.7)
Education	
Less than High School	20.6 (11.6)
High School	22.9 (11.3)
Some College	24.2 (12.0)
College Graduate or More	22.9 (12.8)
Marital Status	
Married	20.8 (11.6)
Never Married	24.2 (11.9)
Widowed, Separated, or Divorces	23.5 (11.4)
Cohabiting	22.3 (12.3)
Age* (correlation coefficient)	-0.13
<i>Pregnancy Characteristics</i>	
Abortion Trimester	
First	23.5 (12.0)
Second	20.4 (11.7)
Abortion Type	
Surgical	22.9 (11.6)
Medication	23.9 (12.6)
<i>Past Adversities</i>	
Intimate Partner Violence in the Past 6 Months***	
Yes	27.5 (11.8)
No	21.1 (11.5)
Reproductive Coercion in the Past 6 Months**	
Yes	28.0 (11.9)
No	22.3 (11.8)
Total Number of Childhood Adversities*** (correlation coefficient)	
	0.34
<i>Relationship Context</i>	
Number of Sexual Partners in the Past 6 Months⁺⁺	
One partner	22.5 (12.3)
Multiple Partners	25.4 (10.7)
<i>Previous Pregnancies Characteristics</i>	
Prior Abortions	
None	23.8 (11.7)

One or More	22.6 (12.3)
Prior Children**	
None	25.5 (11.9)
One or More	21.1 (11.6)
<i>Future Pregnancy Desires</i>	
Important to Prevent Pregnancy in the Next Year	
Yes	22.8 (11.9)
No	24.5 (12.1)
Desire to Become Pregnant in 3 Years or More or Never	
Yes	22.6 (12.1)
No	24.5 (11.6)

Notes. One-way ANOVA F-tests were used to test whether there were differences in depressive symptoms score by race/ethnicity, education, and marital status. Student's t-tests were used to test the differences in depressive symptoms score by binary variables.

++ p<0.1, *p<0.05, **p<0.01, ***p<0.001

Table 1-3. Bivariate relationship between the level of contraceptive choice effectiveness and the covariates (N= 345)

<i>Variables</i>	<i>Effectiveness Levels of Contraceptive Choice, %</i>		
	Low (N= 25)	Moderate (N= 188)	High (N= 132)
<i>Demographic Characteristics</i>			
Race and Ethnicity			
White, Non-Hispanic	20.0	28.7	26.5
Black, Non-Hispanic	36.0	17.6	21.2
Hispanic	24.0	29.3	28.0
Other	20.0	24.5	24.2
Education			
Less than High School	4.0	10.1	12.9
High School	28.0	22.9	23.5
Some College	52.0	43.6	42.4
College Graduate or More	16.0	23.4	21.2
Marital Status			
Married	4.0	10.1	13.6
Never Married	68.0	54.3	47.7
Widowed, Separated, or Divorces	12.0	9.0	9.6
Cohabiting	16.0	26.6	28.8
Age [Mean (SD)]	26.8 (6.3)	25.9 (6.0)	25.9 (6.1)
<i>Pregnancy Characteristics</i>			
Abortion Trimester*			
First	84.0	95.7	90.9
Second	16.0	4.3	9.1
Abortion Type*			
Surgical	72.0	62.2	76.5
Medication	28.0	37.8	23.5
<i>Past Adversities</i>			
Intimate Partner Violence in the Past 6 Months*			
Yes	56.0	33.5	30.3
No	44.0	66.5	69.7
Reproductive Coercion in the Past 6 Months			
Yes	16.0	14.4	18.9
No	84.0	85.6	81.1
Number of Childhood Adversities* [Mean (SD)]	3.7 ^a (1.7)	2.5 ^b (2.2)	2.8 ^{ab} (2.0)
<i>Relationship Context</i>			
Number of Sexual Partners in the Past 6 Months**			
One Partner	48.0	76.6	79.5

Multiple Partners	52.0	23.4	20.5
<i>Previous Pregnancies Characteristics</i>			
Prior Abortions			
None	64.0	55.9	47.7
One or More	36.0	44.1	52.3
Prior Children*			
None	56.0	54.8	39.4
One or More	44.0	45.2	60.6
<i>Future Pregnancy Desires</i>			
Important to Prevent Pregnancy in the Next Year*			
Yes	60.0	71.8	81.1
No	40.0	28.2	18.9
Desire to Become Pregnant in 3 Years or More or Never*			
Yes	44.0	64.9	72.7
No	56.0	35.1	27.3
Depression Score			
Below 35	72.0	83.0	84.8
At or above 35	28.0	17.0	15.2
Depressive Symptoms* [Mean (SD)]	30.0 ^a (9.4)	22.4 ^b (11.9)	23.1 ^b (12.1)

Notes. Chi square tests were conducted to find the differences for categorical variables and one-way ANOVA F-tests were used to find mean and standard deviations for age and total number of childhood adversities.

For depressive symptoms and number of childhood adversities, means with different superscripts are significantly different at $p < 0.05$.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 1-4. The unadjusted and adjusted relationship between depressive symptoms and the effectiveness levels of contraceptive method choice using continuous and dichotomized depressive symptoms score (N=345)

<i>Variables</i>	<i>Effectiveness Levels of Contraceptive Choice, OR (95% CI)</i>		
	Low vs. Moderate	Low vs. High	Moderate vs. High
Depressive Symptoms Score Continuous			
Unadjusted Model 1a	1.051** (1.016, 1.087)	1.046* (1.011, 1.083)	0.996 (0.977, 1.015)
Adjusted Model 2a	1.063** (1.022, 1.105)	1.051* (1.010, 1.093)	0.989 (0.969, 1.009)
Adjusted Model 3a	1.054* (1.008, 1.102)	1.045 ⁺⁺ (0.998, 1.093)	0.991 (0.969, 1.014)
Depressive Symptoms Score Dichotomized at 35			
Unadjusted Model 1b	1.896 (0.732, 4.913)	2.178 (0.806, 5.886)	1.149 (0.625, 2.112)
Adjusted Model 2b	2.152 (0.772, 6.000)	2.235 (0.764, 6.534)	1.038 (0.552, 1.954)
Adjusted Model 3b	1.763 (0.580, 5.356)	1.922 (0.599, 6.162)	1.098 (0.563, 2.141)

Notes. Regression Model 2 was adjusted for Race and ethnicity (ref. White, non-Hispanic); Education (ref. College graduate or more); Marital status (ref. never married); Trimester of abortion (1= second, 0= first); Number of previous children (1= one or more, 0 = none); Number of previous abortions (1= one or more, 0 = none); Very important to avoid pregnancy in the next year (1= yes, 0= no); Regression Model 3 was adjusted for Race and ethnicity (ref. White, non-Hispanic); Education (ref. College graduate or more); Marital status (ref. never married); Trimester of abortion (1= second, 0= first); Type of abortion (1= surgical, 0= medication); Experiencing any IPV (1 = none, 0= yes); Experiencing any pregnancy coercion (1= none, 0= yes); Number of sex partners in the past 6 months (0= one sex partner, 1=more than one partner); Number of previous children (1= one or more, 0 = none); Number of previous abortions (1= one or more, 0 = none); Very important to avoid pregnancy in the next year (1= yes, 0= no); and Desire to have children in three or more years or never (1= yes, 0 = no).

⁺⁺p<0.1, *p<0.05, **p<0.01.

Table 1-5. The unadjusted and adjusted relationship between depressive symptoms and the effectiveness levels of contraceptive method choice (N=345)

<i>Variables</i>	<i>Effectiveness Levels of Contraceptive Choice[~], OR (95% CI)</i>		
	Low vs. Moderate	Low vs. High	Moderate vs. High
<i>Adjusted Model 3a</i>			
Depressive Symptoms Score^a	1.054* (1.008, 1.102)	1.045 ⁺⁺ (0.998, 1.093)	0.991 (0.969, 1.014)
Race and Ethnicity^b			
Black, non-Hispanic	3.194 (0.787, 12.956)	3.419 ⁺⁺ (0.803, 14.555)	1.070 (0.514, 2.231)
Hispanic	0.923 (0.227, 3.756)	1.032 (0.243, 4.386)	1.118 (0.590, 2.120)
Others	0.958 (0.209, 4.384)	0.979 (0.205, 4.682)	1.022 (0.520, 2.009)
Age	1.061 (0.961, 1.172)	1.098 ⁺⁺ (0.991, 1.217)	1.034 (0.985, 1.086)
Marital Status^c			
Married	0.927 (0.082, 10.546)	0.891 (0.078, 10.197)	0.960 (0.418, 2.205)
Never Married	1.634 (0.420, 6.357)	2.058 (0.515, 8.221)	1.259 (0.696, 2.278)
Widowed/Separated/Divorces	1.666 (0.226, 12.272)	1.917 (0.248, 14.805)	1.151 (0.446, 2.969)
Education^d			
Less than High School	0.544 (0.045, 6.599)	0.675 (0.054, 8.433)	1.242 (0.498, 3.099)
High School	1.885 (0.401, 8.864)	2.163 (0.442, 10.574)	1.147 (0.547, 2.405)
Some College	1.420 (0.363, 5.553)	1.567 (0.387, 6.356)	1.104 (0.587, 2.075)
Abortion Trimester^e	0.192* (0.040, 0.928)	0.366 (0.078, 1.722)	1.905 (0.701, 5.179)
Abortion Type^f	1.091 (0.373, 3.193)	0.574 (0.186, 1.767)	0.526* (0.308, 0.899)
Number of Childhood Adversities	1.029 (0.806, 1.314)	0.946 (0.736, 1.215)	0.919 (0.812, 1.040)
Intimate Partner Violence in the Past 6 Months^g	1.768 (0.639, 4.894)	2.543 ⁺⁺ (0.887, 7.286)	1.438 (0.837, 2.471)
Reproductive Coercion in	0.699	0.482	0.690

the Past 6 Months^h	(0.189, 2.582)	(0.126, 1.844)	(0.355, 1.341)
Number of Sexual Partners in the Past 6 Monthsⁱ	2.866* (1.050, 7.824)	3.308* (1.166, 9.389)	1.154 (0.634, 2.101)
Prior Children^j	1.040 (0.332, 3.252)	0.556 (0.172, 1.800)	0.535* (0.296, 0.967)
Prior Abortions^k	0.531 (0.187, 1.512)	0.424 (0.145, 1.239)	0.798 (0.481, 1.325)
Important to Prevent Pregnancy in the Next Year^l	0.956 (0.326, 2.804)	0.590 (0.191, 1.826)	0.617 (0.337, 1.128)
Desire to Become Pregnant in 3 Years or More or Never^m	0.456 (0.160, 1.351)	0.390 ⁺⁺ (0.129, 1.175)	0.838 (0.484, 1.453)

Notes. a= Continuous measure of depressive symptoms score; b=Race and ethnicity (ref. White, non-Hispanic); c=Education (ref. College graduate or more); d=Marital status (ref. never married); e=Trimester of abortion (1= second, 0= first); f=Type of abortion (1= surgical, 0= medication); g=Experiencing any IPV (1 = none, 0= yes); h=Experiencing any pregnancy coercion (1= none, 0= yes); i=Number of sex partners in the past 6 months (0= one sex partner, 1=more than one partner); j=Number of previous children (1= one or more, 0 = none); k=Number of previous abortions (1= one or more, 0 = none); l=Very important to avoid pregnancy in the next year (1= yes, 0= no); m=Desire to have children in three or more years or never (1= yes, 0 = no).
⁺⁺ p<0.1, *p<0.05; ~ multinomial logistic regression models were used to produce the ORs for the three comparison groups.

Chapter 4: Study Two

Title: Association between depressive symptoms and contraceptive method discontinuation

Abstract

Objective: To examine the association between depressive symptoms and contraception discontinuation and pregnancy among young adult women using contraceptive methods. **Method:** We used survival analysis to determine the incidence rates of contraceptive method discontinuation and pregnancy among 666 women initiating a new method in reproductive health visits during a 12-month study period. We used Cox proportional hazards models to assess the independent association between a four-level measure of depressive symptoms (no depressive symptoms, history of elevated depressive symptoms only, baseline elevated depressive symptoms only, baseline and history of elevated depressive symptoms) and contraceptive method discontinuation and pregnancy, adjusting for relevant covariates **Results:** We found that compared to women with no history of elevated depressive symptoms (IR: 2.48/1000 woman-day, 95% CI 2.20, 2.81), those with a history of elevated depressive symptoms only (IR: 2.74/1000 woman-day, 95% CI 2.10, 3.57) and those with both baseline and history of elevated depressive symptoms (IR: 2.98/1000 woman-day, 95% CI 2.01, 4.41) had higher incidences of contraception discontinuation respectively. However, these differences were not statistically significant. Examining the Cox proportional hazard models for all contraceptive methods combined, we found that women with a history of elevated

depressive symptoms only (HR: 1.12, 95% CI 0.86, 1.47) and women experiencing baseline and history of elevated depressive symptoms (HR: 1.39, 95% CI 0.91, 2.11) had a higher hazard of discontinuing their contraceptive methods during the 12 months of study period than those with no experience of elevated depressive symptoms. However, these differences were not statistically significant at $p < 0.05$. Similar results were found for pregnancy outcome. When stratified by contraceptive method type, we found that among patch users, those with a history of elevated depressive symptoms only had a higher probability of discontinuing their contraceptive method (HR: 269.12, 95% CI 14.81, 4891.08) than women with no elevated depressive symptoms. Similarly, among injectable users, compared to women with no elevated depressive symptoms, those with both baseline and history of elevated depressive symptoms had a higher hazard of discontinuing their shots (HR: 10.29, 95% CI 2.81, 37.67). **Conclusion:** Although not statically significant for all contraceptive methods combined, the findings suggest that experiencing elevated depressive symptoms may negatively influence women's decision to continue contraception and may increase their risk of becoming pregnant compared to non-depressed women. Future studies are needed to further explore the link between women's mental health and their contraceptive behaviors in larger cohorts.

Introduction

Forty-three percent of unintended pregnancies in the United States occur among contraception users (Sonfield, Hasstedt, & Gold, 2014). Women's contraceptive behaviors can influence their risk of unintended pregnancy (Blumenthal et al., 1994; Forrest, 1994). Considering the failure rates of contraceptive methods are in part dependent on user behaviors (Trussell, 2011), promoting the initiation and continuous use of effective contraceptive methods can help prevent unintended pregnancies.

Despite an increase in the use of modern reversible contraceptive methods over the years, the rates of method continuation are still low in the US (Peipert et al., 2011). Common factors associated with contraceptive method discontinuation include perceived weight gain from hormonal contraceptive methods, other perceived side effects, dissatisfaction with the contraceptive method, and feelings of ambivalence about becoming pregnant (Hall, White, Rickert, Reame, & Westhoff, 2013c; Moreau, Cleland, & Trussell, 2007; O'Connell, Davis, & Kerns, 2007; Westhoff et al., 2007). In addition to these factors, mental health conditions, particularly depression, has been shown to be associated with women's contraceptive behaviors and unintended pregnancy (Daniels, Daughtery, Jones, & Mosher, 2015; Francis, Presser, Malbon, Braun-Couville, & Linares, 2015; Frost, Singh, & Finer, 2007; Frost, Lindberg, & Finer, 2012; Garbers, Correa, Tobier, Blust, Chiasson, 2010; Hall Yasamin, Gatny, & Barber, 2014; Hall, Steinberg, Cwiak, Allen, & Marcus, 2015; Morrison et al., 2016; Raine et al., 2011; Steinberg et al., 2013; Steinberg & Rubin, 2014).

A few previous studies examining the relationship between depression and contraceptive method continuation have found that women experiencing depressive symptoms are more likely to discontinue their contraceptive method over time than women with no depressive symptoms (Hall et al., 2012; Westhoff et al., 1998a; Westhoff et al., 1998b; Zink et al., 2002). For instance, using a sample of young women 13-24 years old initiating oral contraceptives, Hall and colleagues found that women with more depressive symptoms had higher odds of discontinuing their method after six months (Hall et al., 2012). Similarly, Zink et al, found that adolescent girls with mental distress were less likely to continue their prescription contraception compared to girls with no mental distress after 12 months (Zink et al, 2002). Two other studies found that women who discontinued their implant and the Depot-Provera shot had higher depressive symptoms score at baseline than those who were still continuing their methods at 6 and 24 months follow-ups (Westhoff et al., 1998a; Westhoff et al., 1998b). Three of these studies used only a baseline measure of depressive symptoms (Hall et al., 2012; Westhoff et al., 1998a; Westhoff et al., 1998b) and one used a retrospective measurement of mood disorders including depression based on medical records (Zink et al, 2002). Therefore, these findings do not adequately address whether the persistence of depressive symptoms in women influences their contraceptive method continuation over time. Examining women's current depressive symptoms and their depressive mood history can provide a broader understanding of how persistence of depressive symptoms over time may influence women's compliance with their contraceptive methods and how it may be associated with a subsequent unintended pregnancy.

The purpose of this study is, therefore, to investigate the independent association between history and current depressive symptoms—both separately and combined—and contraceptive method discontinuation and pregnancy during a 12-month time period among low-income women seeking family planning or abortion services in different regions of the United States. While other studies have looked at these outcomes separately for different contraceptive methods, this study will examine the association for all contraceptive methods combined, separately for each individual method, and for three groups of methods based on their effectiveness level.

Material and Methods

Data

Data for this study were collected from a cohort of 1,500 women seeking abortions or other reproductive health services at 40 Planned Parenthood Federation of America (PPFA) health clinics across the United States. This cohort was part of the National Trial of Contraceptive Acceptability (NTOCA), which was a clustered randomized control trial at 40 PPFA clinics, that provided contraceptive training on long-acting reversible contraceptive (LARC) methods to providers at 20 randomly selected sites from 2011-2013. The recruitment of a cohort of women took an average of 2 months at each site. Women were surveyed on contraceptive use, knowledge, attitudes and beliefs, pregnancy history, experiences with healthcare providers, and partner's attitude toward contraception at baseline, 3, 6, 9, and 12 months (Harper et al., 2015). In addition, at baseline, 6, and 12 months, depressive symptoms were assessed using the 10-item Center for Epidemiologic Studies Depression (CES-D)

Scale (Anderson, Malmgren, Carter, & Patrick, 1994). The lifetime history of experiencing depressive symptoms was also measured at the 12-month follow-up using Patient Health Questionnaire (PHQ) 9-item Primary Care Evaluation of Mental Disorders (PRIME-MD) instrument (Spitzer, Kroenke, & Williams, 1999). The 12-month patient follow-up rate was 84% (Bixby Center for Global Reproductive Health, 2016). The study was limited to women 18-25 years old who were sexually active within 3 months prior to the survey and initiated a new method of contraception at baseline (n=831).

Measures

Primary outcome: Incidence of contraceptive method discontinuation in 12 months

We defined the incidence of contraceptive method discontinuation during the 12-month study period for women who initiated a new contraceptive method at baseline (n=831). Information on the incidence of contraception discontinuation was drawn from variables assessing the most effective method women initiated at baseline, whether they discontinued the method at any time during the 12 months of the study, and how many days after baseline they stopped using the method. Using this information, a continuous variable for the number of days from initiation until discontinuation of method was created. Women who reported discontinuing their initial contraceptive method at any time during the 12-month study period were classified as having discontinued their contraceptive method. Women still using their initial contraceptive method at the time of the 12-month interview— i.e. the end of study period—and those exiting the study prior to the end of study period for any reason other than contraceptive method discontinuation were right censored.

Secondary outcome: Incidence of pregnancy in 12 months (367 days)

We defined pregnancy incidence during the 12-month study period for women who initiated a contraceptive method at baseline (n=831). Information on incidence of pregnancy was drawn from variables assessing whether women initiating a new contraceptive method at baseline became pregnant at anytime during the 12-month study period, and how many days from baseline they became pregnant. Using this information, a continuous variable for the number of days from the baseline until pregnancy event was created. Women who reported becoming pregnant at any time during the 12-month study period were classified as pregnant. Women who did not report becoming pregnant by the time of the 12-month interview—i.e. the end of study period— and those who exited the study prior to the end of study period for any reason other than pregnancy were right censored.

Exposure: Depression status

Women's depression status was defined based on the scores of the baseline and history measures of depressive symptoms. Baseline depressive symptoms scores were computed using the 10-item CES-D Scale (Andresen et al., 1994) administered at baseline after contraceptive counseling or prior to abortion procedure for those seeking abortion services. The CES-D 10 instrument assessed how often (0= Never to 3=Often) women experienced depressive symptoms in the past 2 weeks. The scores were the sum of the 10 items and women could be missing data on up to 3 items (n=5 women missed on 4 or more items). For these women, the mean score on the other items was used. Women scoring at or above one standard deviation of the mean (cut-off used by other studies in to identify women at risk for depression in undergoing

abortion procedure) CES-D 10 score (mean score =18.86) were coded as experiencing elevated baseline depressive symptoms.

Women's history of elevated depressive symptoms was defined based on the 9-item PRIME-MD scores (Spitzer et al., 1999), and age at which a woman had first experienced the depressive symptoms, both assessed at the 12-month follow-up survey. The PRIME-MD instrument assessed how often (0=Not at all to 3= Nearly every day) ever during their lifetime before the past two weeks, women had experienced any of the depressive symptoms for a period of 2 weeks or more. The lifetime depression scores were the sum of the 9 items and women could be missing data on up to 3 items (n=94 missed on 4 or more items). For these women, the mean score on the other items was used. Women scoring at or above 10 on the PRIME-MD (the standard cut-off used for depression) were coded as experiencing depressive symptoms sometime before the past two weeks. Based on PRIME-MD scores and the reported age at first experience of depressive symptoms, we determined whether women had elevated past depressive symptoms before the baseline. Women who had PRIME-MD scores at or above 10 and reported an age at first experience of the symptoms younger than their age at baseline were coded as experiencing history of elevated depressive symptoms. Women who had PRIME-MD scores of less than 10 or reported their age at first experience of elevated depressive symptoms as the same age or older than their baseline age were coded as not experiencing history of elevated depressive symptoms.

Using the past and the baseline depression scores, women's depression status was defined as a four-level categorical variable consisting of: 1) no experience of

elevated depressive symptoms, 2) history of elevated depressive symptoms only, 3) elevated baseline depressive symptoms only, and 4) baseline and history of elevated depressive symptoms.

Covariates

Based on the literature we examined the effects of the following baseline characteristics shown to be associated with the outcome of contraceptive discontinuation (Diedrich, Zhao, Madden, Secura, & Peipert, 2015; Grunloh, Casner, Secura, Peipert, & Madden, 2013; Raine et al., 2011): race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Others); type of insurance (private, Medicaid or state insurance, no insurance); use of public assistance (yes/no); type of services sought at baseline (abortion, family planning); partner type (primary, casual, no partner); number of prior abortions (none, one or more); parity (none, one or more); women's feelings about becoming pregnant in the next year (happy, unhappy); the type of contraceptive method used in the last 3 months prior to the study (no method/condoms, hormonal methods, LARC); and the most effective method used at baseline (low, moderate, high). We also controlled for study arm (intervention vs. control) in all models.

Analyses

We compared baseline characteristics of women who discontinued their contraceptive method to those who did not during the 12-month study period using chi-square tests for categorical variables and student t-test for women's age. Similarly, we compared baseline characteristics of women who became pregnant to

those who did not during the 12-month study period using chi-square tests for categorical variables and student t-test for women's age. We performed similar analysis to compare women in different depression groups on the baseline characteristics. The incidence rate of contraceptive method discontinuation was determined by dividing the number of women who discontinued their contraceptive methods by the total number of person-days accumulated in the study population at baseline.

To examine the relationship between depression status and contraceptive method discontinuation over 12 months, we employed Cox proportional hazards models with adjusted standard errors for clustered data. The study time began at baseline (origin) and it ended for women when they reported discontinuing their initial contraceptive method, were lost to follow-up, or when study ended at the 12-month survey interview, whichever came first. Hazard ratios and 95% confidence intervals were then estimated for all contraceptive methods combined, for the three levels of contraceptive method effectiveness (Trussell, 2011), and for each specific contraceptive method initiated at baseline (supplementary analyses). We examined the unadjusted and then the adjusted Cox proportional hazard models for baseline characteristics shown to be associates with contraception discontinuation based on the literature (Diedrich et al., 2015; Grunloh et al., 2013; Raine et al., 2011) or those that were associated with either the discontinuation or depression status in our sample. We conducted the same analyses for our secondary outcome, incidence of pregnancy during the 12-month study period.

Results

Descriptive characteristics of sample

From 831 women initiating a new method at baseline interview, 165 were missing data on depression status or any of the covariates and therefore were excluded from the final analysis leaving 666 in the analytic sample. The total time at risk to contraceptive method discontinuation was 151,634.55 woman-days; the median at-risk time was 273.6 days and ranged from 4 to 364.8 days. Table 2-1 presents the baseline characteristics of the sample. The mean age of the participants was 21, ranging from 18 to 25 years old. Forty-nine percent of women reported being from a non-Hispanic white background, 39% reported not having any insurance, and the majority (73%) reported using public assistance. Approximately 83% of women reported having a primary partner, and 63% and 73% of women reported having no children and no prior abortions respectively. Most women (83%) reported feeling unhappy about becoming pregnant in the next year. More than 60% of women reported using condoms or no contraception during the three months prior to the beginning of the study. At baseline, 35% reported initiating birth control pills while only 7.5% of women reported initiating implants. Approximately 58% of women discontinued their contraceptive method at some point during the 12-month follow-up. The majority of women (68%) had no experience of elevated depressive symptoms, 13% had a history of elevated depressive symptoms only, 12% were experiencing elevated depressive symptoms at baseline only, and 7% had an experience of both baseline and history of elevated depressive symptoms.

Differences by contraceptive method discontinuation

Women who discontinued their contraception during the study period (n=383) were more likely to have no partner (11% vs. 7%) or a casual partner (10% vs. 4%) than those who did not discontinue their contraceptive method respectively (p-values<0.05) during the study period. Furthermore, women who discontinued their contraceptive methods during the study period were more likely to feel happy about becoming pregnant in the next year (20% vs. 14%, p=0.041) and to have initiated condom use at baseline (18% vs. 8%, p<0.001) than those who did not discontinue their contraceptive method. There were no other differences between women who discontinued their contraceptive methods and those who did not with respect to other baseline characteristics (Table 2-1).

Differences by pregnancy status

As presented in Table 2-2, of the 666 women in the final analysis, 108 became pregnant during the study period. Pregnant women were more likely to be black, non-Hispanic (27% vs. 15%, p=0.007) than non-pregnant women; pregnant women were also more likely to report having one child (34% vs. 18%, p<0.001) and one or more prior abortions (39% vs. 24%, p=0.002) compared to their non-pregnant counterparts. Pregnant women were also more likely to feel happy about becoming pregnant in the next year (24% vs. 16%, p=0.041) than those who did not become pregnant. Furthermore, pregnant women were different from their non-pregnant counterparts in the type of contraceptive method used in three months prior to the study (p=0.001), and the type of contraceptive method initiated at baseline (p=0.034).

Differences by depression status

Table 2-3 presents a comparison of women in different depression groups on baseline characteristics. Women in depression group were different from each other with respect to women's race/ethnicity ($p=0.002$), use of public assistance ($p=0.015$), type of partner ($p=0.001$), feeling happy about becoming pregnant in the next year ($p=0.020$), type of contraceptive method used three months prior to the study ($p=0.035$), the contraceptive method initiated at baseline ($p=0.005$), and type of service sought at enrollment visit ($p<0.001$).

Incidence rate of contraceptive method discontinuation

The overall incidence rate of contraceptive method discontinuation was 2.53/1,000 woman-days (95% CI 2.28, 2.79). The incidence rate of contraception discontinuation was higher for women experiencing both baseline and history of depressive symptoms (2.98/1,000 woman-days, 95% CI 2.01, 4.41) than for those with no depressive symptoms (2.48/1,000 woman-days, 95% CI 2.20, 2.81) but this difference was not statistically significant (overlapping confidence intervals). The incidence rate of discontinuation was 0.78/1,000 woman-days (95% CI 0.45, 1.39) for women initiating an implant at baseline and it was significantly lower than in women initiating any other contraceptive method except IUD (95% CI 0.45, 1.34). Similarly, the incidence rate of contraception discontinuation was significantly four times higher in women initiating a low effectiveness contraceptive method (4.05/1,000 woman-days, 95% CI 3.20, 5.14) than in women initiating a high effectiveness contraceptive method (0.91/1,000 woman-days, 95% CI 0.68, 1.21). The incidence of contraception

discontinuation did not differ with respect to other baseline characteristics (Table 2-4).

Incidence rate of pregnancy

As shown in Table 2-5 the overall incidence rate of pregnancy was 4.89/10,000 woman-days (95% CI 4.05, 5.90) and it was about two times higher in women experiencing both baseline and history of depressive symptoms (8.71/10,000 woman-days, 95% CI 4.82, 15.73) than in women with no depression (4.92/10,000 woman-days, 95% CI 3.92, 6.18), however this difference was not statistically significant. The incidence rate of pregnancy was significantly two times higher in black non-Hispanic women (8.40/10,000 woman-days, 95% CI 5.83, 12.08) than in white non-Hispanic women (4.11/10,000 woman-days, 95% CI 3.07, 5.50). Similarly, the incidence rate of pregnancy was significantly 2.5 times higher in women who had one previous birth (8.76/10,000 woman-days, 95% CI 6.35, 12.10) than those with no previous births (3.52/10,000 woman-days, 95% CI 2.69, 4.61). The incidence of pregnancy was also significantly higher in women with one or more prior abortions (7.48/10,000 woman-days, 95% CI 5.53, 10.13) than in those with no previous abortions (4.00/10,000 woman-days, 95% CI 3.14, 5.10). Furthermore, the incidence of pregnancy was significantly higher for those using a LARC method (10.91/10,000 woman-days, 95% CI 5.87, 20.27) three months prior to the beginning of the study than those who used hormonal method during the same time period (2.92/10,000 woman-days, 95% CI 1.92, 4.43). The incidence of pregnancy was also approximately twice as high in women seeking abortion services (6.56/10,000

woman-days, 95% CI 5.16, 8.33) than in those seeking family planning (3.45/10,000 woman-days, 95% CI 2.54, 4.68).

Hazard of contraceptive method discontinuation

The results of the crude and the adjusted hazard ratios and the corresponding 95% confidence intervals for different depression groups in the model examining all contraceptive methods combined, are presented in Table 2-6. In the unadjusted model compared to women with no elevated depressive symptoms, women with a history of elevated depressive symptoms (HR: 1.08, 95% CI 0.84, 1.40) and women with both baseline and history of elevated depressive symptoms (HR: 1.18, 95% CI 0.79, 1.78) were at higher hazards of contraceptive method discontinuation respectively; however, these associations were not statistically significant (p-values >0.1). After adjusting for all baseline characteristics, the hazard of contraceptive method discontinuation remained higher for women with a history of elevated depressive symptoms (HR: 1.12, 95% CI 0.84, 1.47) and women with both baseline and history of elevated depressive symptoms (HR: 1.39, 95% CI 0.91, 2.11) than those with no depressive symptoms, but they did not reach statistical significance (p-values > 0.1).

In the fully adjusted model, compared to women with a primary partner at baseline, women with no partner (HR=1.48, 95% CI: 1.11, 1.96; p=0.007) and women with a casual partner (HR=1.80, 95% CI: 1.38, 2.36; p<0.001) had increased hazards of discontinuing their initial contraceptive method over 12 months respectively. Using a LARC method in the three months prior to the start of the study compared to using condoms or no method was also associated with a higher hazard of contraception discontinuation during the study period (HR=1.65; 95% CI: 1.02, 2.67;

p=0.043). Furthermore, compared to women initiating highly effective methods, those initiating a contraceptive method of low (HR=4.29; 95% CI: 2.88, 6.40; p<0.001) or moderate levels effectiveness (HR=3.69; 95% CI: 2.61, 5.23; p<0.001) at baseline had a higher hazard of discontinuation during the study period.

Hazard of pregnancy

As presented in Table 2-7, with respect to pregnancy outcomes, in the unadjusted Cox proportional hazards model, compared to women with no elevated depressive symptoms, women with a history of elevated depressive symptoms had lower hazard of becoming pregnant during the 12-month study follow-up, though the difference was only marginally significant (HR= 0.53, 95% CI: 0.28, 1.02; p=0.058). After adjusting for all baseline characteristics, this association was no longer marginally significant (HR=0.62; 95% CI: 0.31, 1.24; p=0.179). There were no significant associations between other depression groups and the hazard of pregnancy over 12 months of study period.

In the adjusted model for pregnancy, women with one previous birth had an increased hazard of becoming pregnant over 12 months compared to women with no previous births (HR= 1.90, 95% CI: 1.30, 2.80; p=0.001). Similarly, women with one or more previous abortions compared to those with no abortions had an increased hazard of becoming pregnant in the follow-up period (HR= 1.60, 95% CI: 1.01, 2.53; p=0.044). The hazard of becoming pregnant during the study period decreased by 28% in women who expressed feeling unhappy about becoming pregnant compared to those who expressed happiness in becoming pregnant in the next year (aHR=0.62; 95% CI: 0.39, 0.98; p=0.041). Women who reported using LARC method three

months prior to the study had a higher likelihood of experiencing pregnancy during the study period (HR=2.47; 95% CI: 1.17, 5.22; p=0.018). Finally, initiating a contraceptive method of moderate effectiveness compared to high effectiveness at baseline was associated with an increased hazard of experiencing pregnancy during the study period (HR=2.03; 95% CI: 1.16, 3.57; p=0.014).

Supplementary analyses

Table 2-A1 in Appendix A presents the unadjusted and adjusted hazard ratios of contraceptive method discontinuation and the corresponding 95% confidence intervals associated with depression status for each contraceptive method and the effectiveness level of methods initiated at baseline.

Unadjusted models

In the unadjusted models, among women who reported using birth control pills, compared to those with no elevated depressive symptoms, women with both baseline and history of elevated depressive symptoms had an increased hazard of discontinuing their contraceptive method during the study period (HR= 1.90, CI: 1.16, 3.09; p=0.01). Among women who reported initiating a patch at baseline, compared to women with no elevated depressive symptoms, those with the history of elevated depressive symptoms only had 3.88 higher hazards of discontinuing their patch during study follow-up (95% CI: 1.87, 8.07; p<0.001). Among women who reported initiating a ring at baseline, women with elevated baseline depressive symptoms only, had a higher likelihood of discontinuing their method during the 12-month follow-up compared to those with no experience of elevated depressive

symptoms (HR=2.11; 95% CI: 1.08, 4.12; p=0.029). Furthermore, among women who reported using the injectable at baseline, women with both baseline and history of elevated depressive symptoms had an increased hazard of discontinuing their shots during the 12 months of study period (HR= 4.40, 95% CI: 2.83, 6.86; p<0.001). Finally, among women initiating any contraception of moderate effectiveness, those with a baseline and history of elevated depressive symptoms were at 84% increased risk of discontinuing their method compared to women with no elevated depressive symptoms (HR= 1.84, 95% CI: 1.23, 2.76; p=0.003).

Adjusted models

In the adjusted models, among patch users, women with a history of elevated depressive symptoms had a higher hazard of contraceptive method discontinuation (HR=269.12; 95% CI: 14.81, 4891.08; p<0.001) and among the injectable users, women with both baseline and history of elevated depressive symptoms had a higher hazard of contraception discontinuation (HR=10.29; 95% CI: 2.81, 37.67; p<0.001) compared to never depressed women respectively. In the adjusted models among those who reported initiating an implant at baseline, women with a history of depression also had higher hazard of discontinuing their implant than those with no experience of depression (HR=14.71; 95% CI: 1.23, 2.76; p=0.034).

Discussion

To our knowledge this is the first study to examine the association between depression and contraceptive method discontinuation using a combination of baseline and history of depression as a measure of exposure. When examining the hazard of

discontinuation for all contraceptive methods combined, we found that a history of elevated depressive symptoms only, and a combination of baseline and history of elevated depressive symptoms increased the hazard of contraceptive method discontinuation by 39% and 12% respectively, though these findings did not reach statistical significance.

In this study we do not know whether elevated depressive symptoms in women experiencing the symptoms only in the past persisted over time or not; however, using a combination of history and baseline depressive symptoms—measured at the time of contraceptive method initiation—to define the depression status allowed for a distinction between women experiencing both baseline and history of depressive symptoms (indicative of a more chronic condition) and women experiencing elevated depressive symptoms only at present time (indicative of more short-term condition). This distinction provides a more comprehensive picture of how differences in manifestation of depression may influence women's compliance to their contraceptive methods. Future studies can benefit from a prospective design collecting multiple measures of depressive symptoms over time to establish a timeline for women's experience of chronic versus transient depression.

Previous studies examining the link between depression and contraceptive method discontinuation are methodologically different from the current study (Hall et al., 2012; Westhoff et al., 1998a; Westhoff et al., 1998b; Zink et al., 2002). Three of these studies only considered exposure to elevated depressive symptoms at baseline (Hall et al., 2012; Westhoff et al., 1998a; Westhoff et al., 1998b), and the other used merely a retrospective measure defined by diagnostic codes of coexisting mood

disorders including depression recorded in the medical and insurance records of the study participants as a measure (Zink et al., 2002). Furthermore, in all four studies a single type of method was considered as opposed to a broad range of methods.

As mentioned above other studies in the field have found significant associations between depression and contraceptive method discontinuation for specific methods. In our method specific analyses (Appendix A) we also found independent associations between depression status and hazard of discontinuation for the patch and the injectable users. The effectiveness of contraceptive methods in preventing pregnancy is in part dependent on user's contraceptive behaviors (Trussell, 2011). Previous research has indicated that different contraceptive methods have different discontinuation rates (Grunloh et al., 2013; Peipert et al., 2011; Raine et al., 2011). For instance, compared to non-LARC methods, LARC methods have shown to have a lower discontinuation rate (Dierdrich et al., 2015; Rosenstock, Peipert, Madden, Zhao, & Secura, 2012). These differences in adherence to the contraceptive methods are attributable to factors such as user sociodemographic characteristics and levels of user's satisfaction with the method (Grunloh et al., 2013; Peipert et al., 2011; Raine et al., 2011). Studies have also shown depressed women are more likely to stop using certain methods due to their perceived side effects (Hall et al., 2012). In the method specific analyses of this study, depression was significantly associated with discontinuation of the patch and the injectable, adjusting for all covariates. These hormonal methods require effort from the user to be maintained over time and women experiencing depression may be less motivated to adhere to the regimen for maintaining these methods. This suggests that the type of

contraceptive method women use may be a moderating factor in the relationship between depressive mood and contraceptive discontinuation and therefore the effect of depression on women's compliance with contraception may depend on the type of method being used.

Furthermore, differences in sample characteristics between the present study and previous ones may have influenced the findings. For instance, 92% of women in Hall et al., (2012) study reported being from a Hispanic ethnic background, while our sample was more racially/ethnically diverse (Table 1). Since, rates of contraceptive use and discontinuation differ by racial/ethnic groups (Diedrich et al., 2015; Jackson, Karasek, Dehlendorf, & Foster, 2016; Werth, et al., 2015), it is possible that a more heterogeneous sample would mitigate any user specific effects that may influence the contraceptive discontinuation independently of depression status.

Finally, the present study included a sample of women attending both family planning and abortion service clinics, which was different from other studies. Other studies examined sample of women attending a university-affiliated health clinic (Hall et al., 2012), and a sample of women attending family planning clinics within urban hospitals (Westhoff et al., 1998a; Westhoff et al., 1998b). Therefore, different characteristics of contraceptive counseling presented to women at each site in these studies may have influenced what contraception women initiated the study with and whether they complied with their respective method (e.g. Hall et al., 2012).

We also found that type of sexual partner was independently associated with the hazard of contraceptive method discontinuation among women during the study period. It is possible that women who have no- or a casual partner may not have

consistency in their sexual activity and therefore are more likely to be inconsistent in the use of their contraceptive method than women with a primary partner.

Furthermore, we found that compared to those using no method or condoms, women who reported using a LARC method three months prior to the study were at an increased hazard of discontinuing the contraceptive method they initiated at baseline. In addition, these women had a higher hazard of becoming pregnancy during the 12-month study period. In this study approximately 47% of women who reported using LARC methods in the past three months prior to the study, initiated the study with non-LARC methods. Considering LARC methods are the most effective types of contraception in pregnancy prevention with higher user adherence rates (Trussell, 2011) than other methods, women initiating a non-LARC method may have been more likely to discontinue the method and thus have a higher probability of experiencing pregnancy during the study period.

With respect to pregnancy outcome, we found no independent association between depressive symptoms and the hazard of pregnancy during the 12-month follow-up period. This finding is inconsistent with previous studies that found women with more depressive symptoms were at a higher risk for becoming pregnant (Hall et al., 2014; Hall et al., 2017; Takahashi et al., 2012). It is possible that in our study the type of contraceptive method initiated at the beginning of the study moderated the effect of depression status on the probability of becoming pregnant during the study period.

Limitations

The present study has some limitations that should be considered when interpreting the findings. The small number of discontinuation event per depression group may explain the lack of statistical significance in the overall findings of the present study (n= 258 cases in no depression vs. n=25 cases in past and baseline depression groups). Future research should investigate the association between depression status and hazard of contraception discontinuation in a larger sample of women. Therefore, future research should employ more rigorous ways for recruitment of the subjects and consider the recruitment and follow-up time in the calculation of sufficient sample size (Zwiener, Blettner, & Hommel, 2011).

Although in this study multiple measures of depressive symptoms were used to define the exposure, we were only able to rely on baseline and lifetime measures of depressive symptoms. Therefore, we were unable to measure the effect of change in depressive symptoms over the 12-month follow-up period on the probability of contraception discontinuation. For those women with baseline depressive symptoms only or past depressive symptoms only, we do not know whether we are measuring transient depressive symptoms or a more continuous condition that could have been detected if there were multiple measures of depressive symptoms over time. Future research should use multiple prospective measures of depressive symptoms to determine whether persistence of depressive symptoms over time would have a different effect on the contraceptive behaviors of women.

Finally, in this study the contraceptive method initiator comprised of women who had used condoms or no contraception (62%) in the three months prior to the

beginning of the study versus those who had switched from a previously used LARC or hormonal method (38%). The characteristics of these two groups and their contraception preferences may be different thus influencing their baseline contraception initiation and continuation behaviors independently of their mental health status. Future research should stratified analyses based on recent user type.

Despite the lack of statistical significance in findings, the results of this study begin to shed light on the possible role of depression history in women's contraceptive continuation. By addressing the limitations of this study, future research can further investigate the role of women's history of mental health in addition to their current mental health status and provide a more in-depth explanation of how women's mental health is associated with their contraceptive behavior. Furthermore, examining women's history of mental health together with monitoring their current mental status should be part of best practices for contraceptive counseling.

Practitioners providing contraceptive counseling to women at reproductive health or abortion settings should be aware of women's history of mental health and tailor the counseling sessions to the special needs of the women in order to increase women's compliance with their contraceptive method and to prevent unintended pregnancies.

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Tables

Table 2-1. Baseline characteristics of the sample by contraceptive method discontinuation

Characteristics	% Total (N=666)	% Women Discontinued (N=383)	% Women Censored (N=283)	P-value
Depression Status				0.75
No depression	68.32	67.36	69.61	
Depression history only	13.06	14.10	11.66	
Baseline depression only	12.46	12.01	13.07	
History and baseline depression	6.16	6.53	5.65	
Current Age (Mean ± SD & 95% CI)	21.45 ±2.19 (18-25)	21.33 ±0.11 (21.11, 21.56)	21.61 ±0.13 (21.36, 21.86)	0.11
Race/ Ethnicity				0.25
White, Non-Hispanic	48.95	50.13	47.35	
Black, Non-Hispanic	16.67	16.97	16.25	
Hispanic	26.58	26.89	26.15	
Asian/Others	7.81	6.01	10.25	
Insurance Status				0.23
Medicaid/State insurance	28.53	26.37	31.45	
Private	32.43	34.73	29.33	
No insurance	39.04	38.90	39.22	
Public Assistance				0.85
Yes	27.18	26.89	27.56	
No	72.82	73.11	72.44	
Partner Type				0.003
None	9.31	10.97	7.07	
Casual	7.51	9.92	4.24	
Primary	83.18	79.11	88.69	
Parity				0.45
No children	66.37	66.32	66.43	
One child	20.72	21.93	19.08	
Two or more children	12.91	11.75	14.49	
Number of Prior				0.55

Abortions				
No abortion	73.27	74.15	72.08	
One or more	26.73	25.85	27.92	
Happiness about Pregnancy in the Next Year				0.04
Happy	17.27	19.84	13.78	
Unhappy	82.73	80.16	86.22	
First Most Effective Method Used at Baseline				>0.001
Condom	13.81	17.75	8.48	
Pill	34.53	39.95	27.21	
Patch	4.35	6.27	1.77	
Ring	9.76	11.75	7.07	
Injectable	11.26	12.01	10.25	
Implant	7.51	3.13	13.43	
IUD	18.77	9.14	31.80	
First Method Used at Baseline (Effectiveness Level)^a				>0.001
Low	13.81	17.75	8.48	
Moderate	59.91	69.97	46.29	
High	26.28	12.27	45.23	
Most Effective Method Used 3 Months Prior to Study				0.58
None/Condoms	62.31	61.88	62.90	
Hormonal	33.18	32.90	33.57	
LARC ^b	4.50	5.22	3.53	
Service at Enrollment Visit				0.15
Abortion	47.75	50.13	44.52	
Family planning	52.25	49.87	55.48	
Arm of the Study				0.048
Control	46.85	50.13	42.40	
Intervention	53.15	49.87	57.60	
Contraceptive Discontinuation in 12 Months		-----		-----
Yes	57.51			
No	42.49			
Pregnancy Status in 12 Months				>0.001
Yes	16.22	23.24	6.71	

No	83.78	76.76	23.24	
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a. Contraceptive method effectiveness level was determined according to methods' failure rates in a typical use as described in Trussell, 2011. b. Long acting reversible contraception

Table 2-2. Baseline characteristics of the sample by pregnancy status

<i>Characteristics</i>	<i>% Total (N=666)</i>	<i>% Women Pregnant (N=108)</i>	<i>% Women Censored (N= 558)</i>	<i>P-value</i>
Depression Status				0.080
No depression	68.32	68.52	68.28	
Depression history only	13.06	7.41	14.16	
Baseline depression only	12.46	13.89	12.19	
History and baseline depression	6.16	10.19	5.38	
Current Age (Mean±SD, 95% CI)	21.45 ±2.19 (18-25)	21.33 ± 0.21 (20.92, 21.74)	21.47 ± 0.09 (21.29, 21.66)	0.544
Race/ Ethnicity				0.007
White, Non-Hispanic	48.95	41.67	50.36	
Black, Non-Hispanic	16.67	26.85	14.70	
Hispanic	26.58	27.78	26.34	
Asian/Others	7.81	3.70	8.60	
Insurance Status				0.347
Medicaid/State insurance	28.53	34.26	27.42	
Private	32.43	30.56	32.80	
No insurance	39.04	35.19	39.78	
Public Assistance				0.697
Yes	27.18	28.70	26.88	
No	72.82	71.30	73.12	
Partner Type				0.209
None	9.31	11.11	8.96	
Casual	7.51	11.11	6.81	
Primary	83.18	77.78	84.23	
Parity				<0.001
No children	66.37	49.07	69.71	
One child	20.72	34.26	18.10	
Two or more children	12.91	16.67	12.19	
Number of Prior Abortions				0.002
No abortion	73.27	61.11	75.63	
One or more	26.73	38.89	24.37	
Happiness about Pregnancy in the Next Year				0.041
Happy	17.27	24.07	15.95	
Unhappy	82.73	75.93	84.05	
First Most Effective Method Used at Baseline				0.034
Condom	13.81	12.04	14.16	

Pill	34.53	33.33	34.77	
Patch	4.35	8.33	3.58	
Ring	9.76	13.89	8.96	
Injectable	11.26	14.81	10.57	
Implant	7.51	2.78	8.42	
IUD	18.77	14.81	19.53	
First Method Used at Baseline (Effectiveness Level)^a				0.042
Low	13.81	12.04	14.16	
Moderate	59.91	70.37	57.89	
High	26.28	17.59	27.96	
Most Effective Method Used 3 Months Prior to Study				0.001
None/Condoms	62.31	70.37	60.75	
Hormonal	33.18	20.37	35.66	
LARC ^b	4.50	9.26	3.58	
Service at Enrollment Visit				0.001
Abortion	47.75	62.04	44.98	
Family planning	52.25	37.96	55.02	
Arm of the Study				0.016 (0.900)
Control	46.85	46.30	46.95	
Intervention	53.15	53.70	53.05	
Contraceptive Discontinuation over 12 Months				>0.001
Yes	57.51	82.41	47.31	
No	42.49	17.59	52.69	
Pregnancy Status Over 12 Months		_____		_____
Yes	16.22			
No	83.78			

a. Contraceptive method effectiveness level was determined according to methods' failure rates in a typical use as described in Trussell, 2011.

b. Long acting reversible contraception

Table 2-3. The bivariate relationship between depression status and the study variables

<i>Characteristics</i>	<i>Depression Status</i>				<i>P-value</i>
	<i>No Depression (N=455)</i>	<i>History Only (N=87)</i>	<i>Baseline Only (N=83)</i>	<i>History & Baseline (N=41)</i>	
Contraceptive Discontinuation Over 12 Months					0.75
Yes	56.70	62.07	55.42	60.98	
No	43.30	37.93	44.58	39.02	
Pregnancy Status Over 12 Months					0.08
Yes	16.26	9.20	18.07	26.83	
No	83.74	90.80	81.93	73.17	
Current Age (Mean, SD)	21.44 (0.10)	21.41 (0.22)	21.40 (0.24)	21.76 (0.30)	0.63
Race/ Ethnicity					0.002
White, Non-Hispanic	45.27	56.32	50.60	70.73	
Black, Non-Hispanic	18.46	11.49	16.87	7.32	
Hispanic	30.11	18.39	24.10	9.76	
Asian/Others	6.15	13.79	8.43	12.20	
Insurance Status					0.068
Medicaid/State insurance	27.69	19.54	34.94	43.90	
Private	33.63	31.03	30.12	26.83	
No insurance	38.68	49.43	34.94	29.27	
Public Assistance					0.015
Yes	25.93	20.69	31.33	46.34	
No	74.07	79.31	68.67	53.66	
Partner type					0.001
None	7.25	9.20	12.05	26.83	
Casual	7.25	11.49	3.61	9.76	
Primary	85.49	79.31	84.34	63.41	
Parity					0.129
No children	64.84	75.86	61.45	73.17	
One child	22.42	14.94	18.07	19.51	
Two or more children	12.75	9.20	20.48	7.32	
Number of Prior Abortions					0.11
No abortion	76.04	68.97	65.06	68.29	
One or more	23.96	31.03	34.94	31.71	
Happiness about Pregnancy in the Next Year					0.02

Happy	20.00	9.20	15.66	7.32	
Unhappy	80.00	90.80	84.34	92.68	
First Most Effective Method Used at Baseline					0.005
Condom	14.95	13.79	10.84	7.32	
Pill	33.85	31.03	40.96	36.59	
Patch	4.84	1.15	4.82	4.88	
Ring	9.45	17.24	3.61	9.76	
Injectable	12.75	10.34	8.43	2.44	
Implant	8.13	10.34	4.82	0.00	
IUD	16.04	16.09	26.51	39.02	
First Method Used at Baseline (Effectiveness Level)^a					0.35
Low	14.95	13.79	10.84	7.32	
Moderate	60.88	59.77	57.83	53.66	
High	24.18	26.44	31.33	39.02	
Most Effective Method Used 3 Months Prior to Study					0.035
None/Condoms	58.90	60.92	74.70	78.05	
Hormonal	35.82	36.78	21.69	19.51	
LARC ^b	5.27	2.30	3.61	2.44	
Service at Enrollment Visit					<0.001
Abortion	37.80	43.68	90.36	80.49	
Family planning	62.20	56.32	9.64	19.51	
Arm of the Study					0.68
Control	48.13	41.38	46.99	43.90	
Intervention	51.87	58.62	53.01	56.10	

a. Contraceptive method effectiveness level was determined according to methods' failure rates in a typical use as described in Trussell, 2011.

b. Long acting reversible contraception

Table 2-4. Incidence rates for contraceptive method discontinuation by study variables

<i>Characteristics</i>	<i>Number of women discontinued</i>	<i>Woman-days</i>	<i>Incidence rate* (95% CI)</i>
Overall	383	151634.55	2.53 (2.28, 2.79)
Depression			
No depression	258	103809.10	2.48 (2.20, 2.81)
Past depression	54	19722.95	2.74 (2.10, 3.57)
Baseline depression	46	19708.40	2.33 (1.75, 3.12)
Past and baseline depression	25	8394.10	2.98 (2.01, 4.41)
Race/ Ethnicity			
White, Non-Hispanic	192	74017.95	2.59 (2.25, 2.99)
Black, Non-Hispanic	65	24559.20	2.65 (2.08, 3.38)
Hispanic	103	39880.50	2.58 (2.13, 3.13)
Asian/Others	23	13176.90	1.75 (1.16, 2.63)
Insurance Status			
Medicaid/State insurance	101	44404.30	2.27 (1.87, 2.76)
Private	133	48647.40	2.73 (2.31, 3.24)
No insurance	149	58582.85	2.54 (2.17, 2.99)
Public Assistance			
Yes	103	40636.20	2.53 (2.09, 3.07)
No	280	110998.35	2.52 (2.24, 2.84)
Partner Type			
None	42	12910.30	3.25 (2.40, 4.40)
Casual	38	8373.60	4.54 (3.30, 6.24)
Primary	303	130350.65	2.32 (2.08, 2.60)
Parity			
No children	254	101034.55	2.51 (2.22, 2.84)
One child	84	29582.60	2.84 (2.29, 3.52)
Two or more children	45	21017.40	2.14 (1.60, 2.87)
Number of Prior Abortions			
No abortions	284	110517.20	2.57 (2.29, 2.89)
One or more abortions	99	41117.35	2.41 (1.98, 2.93)
Happiness about Pregnancy in the Next Year			
Happy	76	23839.40	3.19 (2.55, 3.99)
Unhappy	307	127795.15	2.40 (2.15, 2.69)
First Most Effective Method Used at Baseline			
Condom	68	16780.80	4.05 (3.20, 5.14)
Pill	153	48670.40	3.14 (2.68, 3.68)
Patch	24	4164.80	5.76 (3.86, 8.60)
Ring	45	12950.40	3.47 (2.59, 4.65)

Injectable	46	17510.40	2.63 (1.97, 3.51)
Implant	12	15233.00	0.78 (0.45, 1.39)
IUD	35	36324.75	0.96 (0.69, 1.34)
First Method Used at Baseline (Effectiveness Level)^a			
High	47	51557.75	0.91 (0.68, 1.21)
Moderate	268	83296.00	3.22 (2.85, 3.63)
Low	68	16780.80	4.05 (3.20, 5.14)
Most Effective Method Used 3 Months Prior to Study			
None/Condoms	237	96243.30	2.46 (2.17, 2.80)
Hormonal	126	48831.65	2.58 (2.17, 3.07)
LARC ^b	20	6559.60	3.05 (1.97, 4.72)
Service at Enrollment Visit			
Abortion	192	70771.20	2.71 (2.36, 3.13)
Family planning	191	80863.35	2.36 (2.05, 2.72)
Arm of the Study			
Intervention	191	83278.65	2.29 (1.99, 2.64)
Control	192	68355.90	2.81 (2.44, 3.23)

* Per 1,000 women-day

a. Contraceptive method effectiveness level was determined according to methods' failure rates in a typical use as described in Trussell, 2011.

b. Long acting reversible contraception

Table 2-5. Incidence rates for pregnancy by study variables

<i>Characteristics</i>	<i>Number of women discontinued</i>	<i>Woman-days</i>	<i>Incidence rate* (95% CI)</i>
Overall	108	221000.50	4.89 (4.05, 5.90)
Depression			
No depression	74	150464.00	4.92 (3.92, 6.18)
Past depression	8	30320.00	2.64 (1.32, 5.28)
Baseline depression	15	27591.00	5.44 (3.28, 9.02)
Past and baseline depression	11	12625.50	8.71 (4.82, 15.73)
Race/ Ethnicity			
White, Non-Hispanic	45	109518.00	4.11 (3.07, 5.50)
Black, Non-Hispanic	29	34539.00	8.40 (5.83, 12.08)
Hispanic	30	58738.50	5.11 (3.57, 7.30)
Asian/Others	4	18205.00	2.20 (0.82, 5.85)
Insurance Status			
Medicaid/State insurance	37	63215.00	5.85 (4.24, 8.08)
Private	33	70850.50	4.66 (3.31, 6.55)
No insurance	38	86935.00	4.37 (3.18, 6.01)
Public Assistance			
Yes	31	60303.00	5.14 (3.61, 7.31)
No	77	160697.50	4.79 (3.83, 5.99)
Partner Type			
None	12	20061.00	5.98 (3.40, 10.53)
Casual	12	15916.00	7.54 (4.28, 13.28)
Primary	84	185023.50	4.54 (3.67, 5.62)
Parity			
No children	53	150493.50	3.52 (2.69, 4.61)
One child	37	42221.00	8.76 (6.35, 12.10)
Two or more children	18	28286.00	6.36 (4.01, 10.10)
Number of Prior Abortions			
No abortions	66	164876.5	4.00 (3.14, 5.10)
One or more abortions	42	56124.00	7.48 (5.53, 10.13)
Happiness about Pregnancy in the Next Year			
Happy	26	36065.50	7.21 (4.91, 10.59)
Unhappy	82	184935.00	4.43 (3.57, 5.50)
First Most Effective Method Used at Baseline			
Condom	13	30631.50	4.24 (2.46, 7.31)
Pill	36	76435.00	4.71 (3.40, 6.53)
Patch	9	8651.00	10.40 (5.41,
Ring	15	21082.50	19.99)

Injectable	16	24549.50	7.11 (4.29, 11.80)
Implant	3	17527.00	6.52 (3.99, 10.64)
IUD	16	42124.00	1.71 (0.55, 5.31) 3.80 (2.32, 6.20)
First Method Used at Baseline (Effectiveness Level)^a			
High	19	59651.00	3.18 (2.03, 4.99)
Moderate	76	130718.00	5.81 (4.64, 7.28)
Low	13	30631.50	4.24 (2.46, 7.31)
Most Effective Method Used 3 Months Prior to Study			
None/Condoms	76	136481.00	5.57 (4.45, 6.97)
Hormonal	22	75352.00	2.92 (1.92, 4.43)
LARC ^b	10	9167.50	10.91 (5.87, 20.27)
Service at Enrollment Visit			
Abortion	67	102140	6.56 (5.16, 8.33)
Family planning	41	118860.5	3.45 (2.54, 4.68)
Arm of the Study			
Intervention	50	104118.5	4.80 (3.64, 6.34)
Control	58	116882	4.96 (3.84, 6.42)

* Per 10,000 women-days

a. Contraceptive method effectiveness level was determined according to methods' failure rates in a typical use as described in Trussell, 2011.

b. Long acting reversible contraception

Table 2-6. Hazard ratios and 95% CIs for the association between all study variables and contraceptive method discontinuation (all methods combined) during the 12 month of follow up period

<i>Characteristics</i>	<i>Unadjusted HR (95% CI)</i>	<i>Adjusted HR (95%CI)</i>
Depression Status		
Depression history only	1.08 (0.84, 1.40)	1.12 (0.86, 1.47)
Baseline depression only	0.93 (0.68, 1.27)	1.03 (0.74, 1.43)
History and baseline depression	1.18 (0.79, 1.78)	1.39 (0.91, 2.11)
No depression	1.00	1.00
Current Age	0.97 (0.93, 1.01)	0.99 (0.93, 1.05)
Race/ Ethnicity		
Black, Non-Hispanic	1.02 (0.75, 1.40)	0.92 (0.69, 1.23)
Hispanic	0.97 (0.81, 1.23)	1.10 (0.87, 1.39)
Asian/Others	0.68 (0.44, 1.05)	0.73 (0.47, 1.11)
White, Non-Hispanic	1.00	1.00
Insurance Status		
Medicaid/State insurance	0.85 (0.66, 1.09)	0.86 (0.64, 1.16)
No insurance	0.94 (0.76, 1.15)	0.98 (0.80, 1.20)
Private	1.00	1.00
Public Assistance		
Yes	1.002 (0.78, 1.28)	1.11 (0.84, 1.49)
No	1.00	1.00
Partner type		
None	1.36 (1.005, 1.83)	1.48 (1.11, 1.96)
Casual	1.80 (1.36, 2.38)	1.80 (1.38, 2.36)
Primary	1.00	1.00
Parity		
One child	1.13 (0.88, 1.45)	1.28 (0.96, 1.70)
Two or more children	0.87 (0.61, 1.24)	1.11 (0.76, 1.64)
No children	1.00	1.00
Number of Prior Abortions		
One or more	0.95 (0.75, 1.19)	0.89 (0.69, 1.16)
No abortion	1.00	1.00
Happiness about Pregnancy in the Next year		
Unhappy	0.77 (0.62, 0.95)	0.82 (0.66, 1.03)
Happy	1.00	1.00
Most Effective Method Used 3 Months Prior to Study		
Hormonal	1.98 (1.06, 3.70)	1.17 (0.93, 1.49)
LARC ^a	4.04 (2.23, 7.34)	1.65 (1.02, 2.67)
None/Condoms	1.00	1.00
Service at Enrollment Visit		

Family planning	0.89 (0.72, 1.09)	0.82 (0.66, 1.01)
Abortion	1.00	1.00
Arm of the Study		
Intervention	0.83 (0.68, 1.01)	0.93 (0.77, 1.12)
Control	1.00	1.00
First Method Effectiveness Level^b		
Low Effectiveness	4.00 (2.77, 5.79)	4.29 (2.88, 6.40)
Moderate Effectiveness	3.28 (2.36, 4.54)	3.69 (2.61, 5.23)
High Effectiveness	1.00	1.00

a. Long acting reversible contraception

b. Contraceptive method effectiveness level was determined according to methods' failure rates in a typical use as described in Trussell, 2011.

Table 2-7. Hazard ratios and 95% CIs for the association between all study variables and pregnancy during the 12-month follow up period

<i>Characteristics</i>	<i>Unadjusted HR (95% CI)</i>	<i>Adjusted HR (95%CI)</i>
Depression Status		
Depression history only	0.53 (0.28, 1.02)	0.62 (0.31, 1.24)
Baseline depression only	1.10 (0.69, 1.75)	0.82 (0.51, 1.32)
History and baseline depression	1.78 (0.87, 3.62)	1.86 (0.86, 4.04)
No depression	1.00	1.00
Current Age	0.97 (0.90, 1.05)	0.93 (0.85, 1.02)
Race/ Ethnicity		
Black, Non-Hispanic	2.04 (1.28, 3.27)	1.46 (0.86, 2.47)
Hispanic	1.24 (0.79, 1.96)	1.15 (0.75, 1.77)
Asian/Others	0.53 (0.20, 1.40)	0.60 (0.22, 1.58)
White, Non-Hispanic	1.00	1.00
Insurance Status		
Medicaid/State insurance	1.25 (0.82, 1.91)	1.32 (0.85, 2.04)
No insurance	0.94 (0.65, 1.34)	1.09 (0.72, 1.64)
Private	1.00	1.00
Public Assistance		
Yes	1.07 (0.75, 1.53)	0.80 (0.50, 1.28)
No	1.00	1.00
Partner type		
None	1.31 (0.69, 2.49)	1.13 (0.55, 2.32)
Casual	1.66 (0.88, 3.12)	1.42 (0.73, 2.75)
Primary	1.00	1.00
Parity		
One child	2.49 (1.76, 3.55)	1.90 (1.30, 2.80)
Two or more children	1.80 (1.03, 3.15)	1.49 (0.79, 2.78)
No children	1.00	1.00
Number of Prior Abortions		
One or more	1.87 (1.30, 2.70)	1.60 (1.01, 2.53)
No abortion	1.00	1.00
Happiness about Pregnancy in the Next year		
Unhappy	0.61 (0.42, 0.90)	0.62 (0.39, 0.98)
Happy	1.00	1.00
Most Effective Method Used 3 Months Prior to Study		
Hormonal	0.52 (0.32, 0.86)	0.73 (0.40, 1.35)
LARC ^a	1.95 (1.08, 3.51)	2.47 (1.17, 5.22)
None/Condoms	1.00	1.00
Service at Enrollment Visit		
Family Planning	0.52 (0.34, 0.81)	0.54 (0.36, 0.81)

Abortion	1.00	1.00
Arm of the Study		
Intervention	1.03 (0.65, 1.64)	1.18 (0.84, 1.66)
Control	1.00	1.00
First Method Effectiveness Level^b		
Low Effectiveness	1.33 (0.70, 2.53)	1.70 (0.80, 3.61)
Moderate Effectiveness	1.83 (1.13, 2.95)	2.03 (1.16, 3.57)
High Effectiveness	1.00	1.00

a. Long acting reversible contraception

b. Contraceptive method effectiveness level was determined according to methods' failure rates in a typical use as described in Trussell, 2011.

Appendix A

Table 2-A1. Hazard ratios and 95% CIs for the association between depression status and contraceptive method discontinuation for individual methods and contraceptive method effectiveness tiers during the 12 months of study period

<i>Characteristics</i>	<i>Unadjusted HR (95% CI)</i>	<i>Adjusted HR (95% CI)</i>
<i>Condoms (n=92)</i>		
Depression Status		
Depression history only	1.01 (0.60, 1.68)	1.04 (0.56, 1.95)
Baseline depression only	0.83 (0.36, 1.95)	0.65 (0.26, 1.66)
History and baseline depression	0.34 (0.04, 3.04)	0.32 (0.02, 4.09)
No depression	1.00	1.00
<i>Pill (n=230)</i>		
Depression Status		
Depression history only	1.27 (0.80, 2.01)	1.22 (0.74, 2.00)
Baseline depression only	1.10 (0.78, 1.57)	1.08 (0.67, 1.75)
History and baseline depression	1.90 (1.16, 3.09)	1.46 (0.75, 2.85)
No depression	1.00	1.00
<i>Patch (n=29)</i>		
Depression Status		
Depression history only	3.88 (1.87, 8.07)	269.12 (14.81, 4891.08)
Baseline depression only	0.84 (0.26, 2.67)	3.65 (0.31, 43.48)
History and baseline depression	0.91 (0.37, 2.25)	1.12 (0.60, 20.94)
No depression	1.00	1.00
<i>Ring (n=65)</i>		
Depression Status		
Depression history only	1.02 (0.52, 2.01)	0.70 (0.29, 1.67)
Baseline depression only	2.11 (1.08, 4.12)	2.37 (0.94, 6.01)
History and baseline depression	1.61 (0.43, 6.12)	2.27 (0.56, 9.21)
No depression	1.00	1.00
<i>Injectable (n=75)</i>		
Depression Status		
Depression history only	1.27 (0.62, 2.62)	2.18 (0.78, 6.04)
Baseline depression only	1.40 (0.52, 3.76)	1.25 (0.35, 4.42)
History and baseline depression	4.40 (2.83, 6.86)	10.29 (2.81, 37.67)
No depression	1.00	1.00
<i>Implant (n=50)</i>		
Depression Status		
Any depression	0.82 (0.27, 2.51)	15.57 (2.12, 114.24)
No depression	1.00	1.00
<i>IUD (n=125)</i>		
Depression Status		

Depression history only	1.01 (0.36, 2.84)	1.00 (0.25, 3.90)
Baseline depression only	0.74 (0.26, 2.07)	0.63 (0.20, 1.96)
History and baseline depression	1.13 (0.40, 3.14)	1.46 (0.30, 7.12)
No depression	1.00	1.00
Low Effectiveness Methods^a (n=92)		
Depression Status		
Depression history only	1.01 (0.60, 1.68)	1.04 (0.56, 1.95)
Baseline depression only	0.83 (0.36, 1.95)	0.65 (0.26, 1.66)
History and baseline depression	0.34 (0.39, 3.04)	0.32 (0.02, 4.09)
No depression	1.00	1.00
Moderate Effectiveness Methods^b (n=399)		
Depression Status		
Depression history only	1.18 (0.85, 1.64)	1.18 (0.83, 1.68)
Baseline depression only	1.16 (0.83, 1.62)	1.17 (0.79, 1.74)
History and baseline depression	1.84 (1.23, 2.76)	1.55 (0.91, 1.04)
No depression	1.00	1.00
High Effectiveness Methods^c (n=175)		
Depression Status		
Depression history only	0.93 (0.42, 2.03)	1.00 (0.40, 2.35)
Baseline depression only	0.64 (0.24, 1.70)	0.59 (0.18, 1.93)
History and baseline depression	1.16 (0.44, 3.10)	1.89 (0.48, 7.49)
No depression	1.00	1.00

a. Low effectiveness includes condoms

b. Moderate effectiveness includes pill, patch, ring, and shot

c. High effectiveness level includes implant and IUD

Appendix B

Table 2-B1. Hazard ratios for baseline characteristics for condom users (n=92)

<i>Characteristics</i>	<i>Unadjusted HR (95% CI)</i>	<i>Adjusted HR (95%CI)</i>
Current Age	1.02 (0.91, 1.15)	1.10 (1.00, 1.25)
Race/ Ethnicity		
Black, Non-Hispanic	0.44 (0.20, 0.99)	0.42 (0.20, 0.88)
Hispanic	1.07 (0.65, 1.75)	0.81 (0.43, 1.53)
Asian/Others	0.96 (0.45, 2.05)	0.74 (0.32, 1.68)
White, Non-Hispanic	1.00	1.00
Insurance Status		
Medicaid/State insurance	1.37 (0.72, 2.62)	1.63 (0.80, 3.29)
No insurance	0.85 (0.54, 1.34)	0.77 (0.48, 1.23)
Private	1.00	1.00
Public Assistance		
Yes	0.94 (0.60, 1.48)	0.73 (0.43, 1.23)
No	1.00	1.00
Partner type		
None	1.29 (0.59, 2.81)	1.13 (0.45, 2.85)
Casual	1.26 (0.52, 3.04)	0.87 (0.36, 2.10)
Primary	1.00	1.00
Parity		
One child	0.60 (0.27, 1.34)	0.76 (0.31, 1.83)
Two or more children	3.71 (2.76, 4.99)	6.23 (2.06, 18.82)
No children	1.00	1.00
Number of Prior Abortions		
One or more	0.68 (0.40, 1.16)	0.63 (0.39, 1.04)
No abortion	1.00	1.00
Happiness about Pregnancy in the Next year		
Unhappy	0.99 (0.62, 1.58)	1.13 (0.66, 1.94)
Happy	1.00	1.00

Most Effective Method Used in 3 Months Prior to Study		
Hormonal	1.98 (1.06, 3.70)	1.31 (0.68, 2.53)
LARC	4.04 (2.23, 7.34)	4.16 (1.72, 10.08)
None/Condoms	1.00	1.00
Service at Enrollment Visit		
Family planning	1.46 (0.94, 2.27)	1.39 (0.81, 2.40)
Abortion	1.00	1.00
Arm of the Study		
Intervention	1.22 (0.77, 1.93)	1.37 (0.81, 2.30)
Control	1.00	1.00

Table 2-B2. Hazard ratios for baseline characteristics for birth control pill users (n=230)

Characteristics	Unadjusted HR (95% CI)	Adjusted HR (95%CI)
Current Age	1.01 (0.94, 1.09)	0.96 (0.89, 1.04)
Race/ Ethnicity		
Black, Non-Hispanic	1.22 (0.90, 1.66)	0.99 (0.70, 1.42)
Hispanic	0.91 (0.64, 1.30)	0.85 (0.59, 1.24)
Asian/Others	0.46 (0.22, 0.95)	0.51 (0.24, 1.10)
White, Non-Hispanic	1.00	1.00
Insurance Status		
Medicaid/State insurance	0.87 (0.60, 1.25)	0.71 (0.46, 1.07)
No insurance	1.01 (0.69, 1.48)	1.13 (0.80, 1.60)
Private	1.00	1.00
Public Assistance		
Yes	1.16 (0.82, 1.64)	1.32 (0.87, 2.01)
No	1.00	1.00
Partner type		
None	1.63 (1.03, 2.58)	1.47 (0.85, 2.53)
Casual	2.56 (1.56, 4.21)	2.17 (1.27, 3.72)
Primary	1.00	1.00
Parity		
One child	1.51 (1.05, 2.19)	1.46 (0.97, 2.19)
Two or more children	1.26 (0.71, 2.23)	1.45 (0.79, 2.69)
No children	1.00	1.00
Number of Prior Abortions		
One or more	1.65 (1.13, 2.40)	1.46 (0.92, 2.33)
No abortion	1.00	1.00
Happiness about Pregnancy in the Next year		
Unhappy	0.86 (0.61, 1.21)	0.80 (0.60, 1.07)
Happy	1.00	1.00
Most Effective Method Used in 3 Months Prior to Study		
Hormonal	1.18 (0.55, 2.57)	1.07 (0.64, 1.79)
LARC	1.17 (0.52, 2.66)	0.64 (0.25, 1.64)
None/Condoms	1.00	1.00
Service at Enrollment Visit		
Family planning	0.75 (0.58, 0.98)	0.85 (0.58, 1.22)
Abortion	1.00	1.00
Arm of the Study		
Intervention	0.88 (0.67, 1.17)	0.91 (0.65, 1.27)
Control	1.00	1.00

Table 2-B3. Hazard ratios for baseline characteristics for patch users (n=29)

<i>Characteristics</i>	<i>Unadjusted HR (95% CI)</i>	<i>Adjusted HR (95%CI)</i>
Current Age	0.94 (0.78, 1.13)	0.69 (0.43, 1.12)
Race/ Ethnicity		
Black, Non-Hispanic	4.96 (2.01, 12.21)	37.64 (3.49, 405.38)
Hispanic	0.93 (0.36, 2.39)	1.09 (0.30, 3.89)
Asian/Others	0.64 (0.32, 1.27)	0.08 (0.0001, 53.67)
White, Non-Hispanic	1.00	1.00
Insurance Status		
Medicaid/State insurance	0.86 (0.37, 1.99)	0.03 (0.002, 0.46)
No insurance	0.84 (0.33, 2.12)	0.10 (0.01, 1.10)
Private	1.00	1.00
Public Assistance		
Yes	1.41 (0.76, 2.60)	3.10 (0.34, 28.30)
No	1.00	1.00
Partner type		
None	1.24 (0.72, 2.13)	3.52 (0.27, 45.30)
Casual	1.24 (0.71, 2.15)	1.82 (0.26, 12.69)
Primary	1.00	1.00
Parity		
One child	1.25 (0.56, 2.79)	7.32 (0.28, 193.53)
Two or more children	0.45 (0.10, 2.10)	1.69 (0.04, 65.27)
No children	1.00	1.00
Number of Prior Abortions		
One or more	0.97 (0.44, 2.13)	0.55 (0.062, 4.82)
No abortion	1.00	1.00
Happiness about Pregnancy in the Next year		
Unhappy	0.71 (0.36, 1.38)	0.62 (0.06, 6.86)
Happy	1.00	1.00
Most Effective Method Used in 3 Months Prior to Study		
Hormonal	1.36 (0.58, 3.20)	1.99 (0.41, 9.58)
LARC	Omitted	Omitted
None/Condoms	1.00	1.00
Service at Enrollment Visit		
Family planning	0.98 (0.49, 1.94)	2.72 (0.39, 18.75)
Abortion	1.00	1.00
Arm of the Study		
Intervention	0.99 (0.53, 1.86)	0.27 (0.03, 2.10)
Control	1.00	1.00

Table 2-B4. Hazard ratios for baseline characteristics for ring users (n=65)

Characteristics	Unadjusted HR (95% CI)	Adjusted HR (95%CI)
Current Age	1.04 (0.92, 1.17)	1.18 (0.95, 1.45)
Race/ Ethnicity		
Black, Non-Hispanic	1.00 (0.44, 2.29)	1.43 (0.39, 5.19)
Hispanic	1.53 (0.87, 2.69)	1.51 (0.72, 3.19)
Asian/Others	2.12 (0.82, 5.49)	3.35 (0.71, 15.89)
White, Non-Hispanic	1.00	1.00
Insurance Status		
Medicaid/State insurance	0.49 (0.23, 1.04)	0.59 (0.19, 1.78)
No insurance	0.61 (0.32, 1.16)	0.62 (0.33, 1.18)
Private	1.00	1.00
Public Assistance		
Yes	0.69 (0.37, 1.28)	0.49 (0.14, 1.68)
No	1.00	1.00
Partner type		
None	1.23 (0.61, 2.48)	0.97 (0.32, 2.96)
Casual	1.03 (0.52, 2.02)	0.97 (0.44, 2.14)
Primary	1.00	1.00
Parity		
One child	1.33 (0.73, 2.44)	0.94 (0.51, 1.73)
Two or more children	0.57 (0.20, 1.61)	0.49 (0.12, 2.01)
No children	1.00	1.00
Number of Prior Abortions		
One or more	1.01 (0.52, 1.99)	0.77 (0.25, 2.36)
No abortion	1.00	1.00
Happiness about Pregnancy in the Next year		
Unhappy	0.72 (0.37, 1.38)	0.56 (0.20, 1.58)
Happy	1.00	1.00
Most Effective Method Used in 3 Months Prior to Study		
Hormonal	1.11 (0.78, 1.58)	1.30 (0.75, 2.27)
LARC	0.78 (0.075, 8.21)	2.81 (0.22, 35.39)
None/Condoms	1.00	1.00
Service at Enrollment Visit		
Family planning	0.69 (0.39, 1.23)	0.53 (0.23, 1.25)
Abortion	1.00	1.00
Arm of the Study		
Intervention	0.75 (0.41, 1.36)	0.75 (0.36, 1.53)

Table 2-B5. Hazard ratios for baseline characteristics for injectable users (n=75)

<i>Characteristics</i>	<i>Unadjusted HR (95% CI)</i>	<i>Adjusted HR (95%CI)</i>
Current Age	0.97 (0.85, 1.10)	1.01 (0.83, 1.22)
Race/ Ethnicity		
Black, Non-Hispanic	0.97 (0.55, 1.72)	0.77 (0.41, 1.48)
Hispanic	1.42 (0.72, 2.80)	0.95 (0.41, 2.20)
Asian/Others	2.15 (0.99, 4.66)	1.83 (0.21, 15.80)
White, Non-Hispanic	1.00	1.00
Insurance Status		
Medicaid/State insurance	1.15 (0.58, 2.29)	1.21 (0.52, 2.79)
No insurance	1.07 (0.59, 1.94)	0.95 (0.40, 2.30)
Private	1.00	1.00
Public Assistance		
Yes	1.31 (0.71, 2.40)	1.67 (0.49, 5.67)
No	1.00	1.00
Partner type		
None	3.90 (2.34, 6.49)	4.16 (2.14, 8.09)
Casual	2.94 (1.75, 4.92)	4.43 (2.04, 9.61)
Primary	1.00	1.00
Parity		
One child	1.19 (0.64, 2.24)	1.88 (0.97, 3.64), .062
Two or more children	1.44 (0.20, 3.06)	0.75 (0.22, 2.63)
No children	1.00	1.00
Number of Prior Abortions		
One or more	0.58 (0.31, 1.10)	0.44 (0.20, 0.99)
No abortion	1.00	1.00
Happiness about Pregnancy in the Next year		
Unhappy	0.87 (0.47, 1.60)	1.12 (0.43, 2.88)
Happy	1.00	1.00
Most Effective Method Used in 3 Months Prior to Study		
Hormonal	0.89 (0.50, 1.59)	1.11 (0.60, 2.05)
LARC	3.11 (1.87, 5.19)	2.78 (0.34, 22.98)
None/Condoms	1.00	1.00
Service at Enrollment Visit		
Family planning	0.71 (0.38, 1.33)	0.65 (0.31, 1.37)
Abortion	1.00	1.00
Arm of the Study		
Intervention	0.67 (0.37, 1.20)	0.86 (0.48, 1.57)
Control	1.00	1.00

Table 2-B6. Hazard ratios for baseline characteristics of implant users (using no-depression versus any-depression, n=50)

Characteristics	Unadjusted HR (95% CI)	Adjusted HR (95%CI)
Current Age	0.81 (0.60, 1.09)	0.81 (0.44, 1.49)
Race/ Ethnicity		
Black, Non-Hispanic	3.21e-16 (8.46e-17, 1.22e-15)	8.09e-15 (2.46e-22, 2.66e-7)
Hispanic	3.00 (0.94, 9.58)	13.89 (0.05, 3712.99)
Asian/Others	3.21e-16 (8.03e-17, 1.29e-15)	1.38e-19 (1.94e-20, 9.77e-13)
White, Non-Hispanic	1.00	1.00
Insurance Status		
Medicaid/State insurance	0.81 (0.36, 1.80)	1.37 (6.95e-6, 271964.3)
No insurance	4.43 (0.71, 27.53)	0.35 (0.008, 14.84)
Private	1.00	1.00
Public Assistance		
Yes	1.44e-16 (5.93e-17, 3.47e-16)	2.89-18 (6.60e-22, 1.27e-14)
No	1.00	1.00
Partner type		
None	0.70 (0.14, 3.56)	0.17 (0.005, 5.41)
Casual	1.59e-15 (1.77e-16, 1.42e-14)	1.10e16 (4.22e12, 2.87e19)
Primary	1.00	1.00
Parity		
One child	1.71 (0.53, 5.45)	2.83 (0.19, 42.96)
Two or more children	1.70 (0.49, 5.90)	8.26 (0.07, 952.64)
No children	1.00	1.00
Number of Prior Abortions		
One or more	5.00e-17 (1.95e-17, 1.28e-16)	6.33e-18 (2.72e-20, 1.47e-15)
No abortion	1.00	1.00
Happiness about Pregnancy in the Next year		
Unhappy	0.45 (0.14, 1.42)	1.08 (0.07, 16.10)
Happy	1.00	1.00

Most Effective Method Used in 3 Months Prior to Study		
Hormonal	1.40 (0.49, 3.97)	2.93 (0.23, 37.10)
LARC	3.83 (0.90, 16.33)	5.87 (0.28, 123.79)
None/Condoms	1.00	1.00
Service at Enrollment Visit		
Family planning	1.62 (0.40, 6.52)	2.30 (0.002, 2097.43)
Abortion	1.00	1.00
Arm of the Study		
Intervention	0.89 (0.25, 3.17)	3.13 (0.18, 55.64)
Control	1.00	1.00

Table 2-B7. Hazard ratios for baseline characteristics for IUD users (n=125)

<i>Characteristics</i>	<i>Unadjusted HR (95% CI)</i>	<i>Adjusted HR (95%CI)</i>
Current Age	0.91 (0.78, 1.07)	0.88 (0.70, 1.12)
Race/ Ethnicity		
Black, Non-Hispanic	1.64 (0.58, 4.64)	1.83 (0.48, 6.96)
Hispanic	1.04 (0.48, 2.28)	0.93 (0.44, 1.95)
Asian/Others	0.42 (0.05, 3.49)	0.48 (0.06, 3.78)
White, Non-Hispanic	1.00	1.00
Insurance Status		
Medicaid/State insurance	0.74 (0.25, 2.17)	0.68 (0.12, 3.73)
No insurance	1.19 (0.63, 2.26)	1.17 (0.57, 2.43)
Private	1.00	1.00
Public Assistance		
Yes	0.85 (0.40, 1.83)	0.78 (0.27, 2.25)
No	1.00	1.00
Partner type		
None	1.18 (0.51, 2.73)	1.13 (0.50, 2.56)
Casual	0.93 (0.20, 4.33)	0.86 (0.13, 5.59)
Primary	1.00	1.00
Parity		
One child	1.83 (0.88, 3.80)	1.29 (0.68, 2.47)
Two or more children	1.20 (0.57, 2.54)	0.92 (0.37, 2.29)
No children	1.00	1.00
Number of Prior Abortions		
One or more	0.79 (0.38, 1.68)	1.09 (0.46, 2.62)
No abortion	1.00	1.00
Happiness about Pregnancy in the Next year		
Unhappy	0.64 (0.30, 1.38)	0.53 (0.19, 1.49)
Happy	1.00	1.00
Most Effective Method Used in 3 Months Prior to Study		
Hormonal	0.75 (0.37, 1.50)	0.70 (0.28, 1.73)
LARC	2.36 (0.99, 5.64)	2.78 (0.85, 9.13)
None/Condoms	1.00	1.00
Service at Enrollment Visit		
Family planning	0.69 (0.32, 1.50)	0.50 (0.19, 1.32)
Abortion	1.00	1.00
Arm of the Study		
Intervention	0.81 (0.38, 1.71)	1.005 (0.42, 2.41)
Control	1.00	1.00

Table 2-B8. Hazard ratios for baseline characteristics for initiation of a low effectiveness method at baseline (n=92)

<i>Characteristics</i>	<i>Unadjusted HR (95% CI)</i>	<i>Adjusted HR (95%CI)</i>
Current Age	1.02 (0.91, 1.15)	1.10 (0.97, 1.25)
Race/ Ethnicity		
Black, Non-Hispanic	0.44 (0.20, 0.99)	0.42 (0.20, 0.88)
Hispanic	1.07 (0.65, 1.75)	0.81 (0.43, 1.53)
Asian/Others	0.96 (0.45, 2.05)	0.74 (0.32, 1.68)
White, Non-Hispanic	1.00	1.00
Insurance Status		
Medicaid/State insurance	1.37 (0.72, 2.62)	1.63 (0.80, 3.29)
No insurance	0.85 (0.54, 1.34)	0.77 (0.48, 1.23)
Private	1.00	1.00
Public Assistance		
Yes	0.94 (0.60, 1.48)	0.73 (0.43, 1.23)
No	1.00	1.00
Partner type		
None	1.29 (0.59, 2.81)	1.13 (0.45, 2.85)
Casual	1.26 (0.52, 3.04)	0.87 (0.36, 2.10)
Primary	1.00	1.00
Parity		
One child	0.60 (0.27, 1.34)	0.76 (0.31, 1.84)
Two or more children	3.71 (2.76, 4.99)	6.23 (2.06, 18.82)
No children	1.00	1.00
Number of Prior Abortions		
One or more	0.68 (0.40, 1.16)	0.63 (0.39, 1.04)
No abortion	1.00	1.00
Happiness about Pregnancy in the Next year		
Unhappy	0.99 (0.62, 1.58)	1.13 (0.66, 1.94)
Happy	1.00	1.00
Most Effective Method Used in 3 Months Prior to Study		
Hormonal	1.98 (1.06, 3.70)	1.31 (0.68, 2.53)
LARC	4.04 (2.23, 7.34)	4.16 (1.72, 10.08)
None/Condoms	1.00	1.00
Service at Enrollment Visit		
Family planning	1.46 (0.94, 2.27)	1.39 (0.81, 2.40)
Abortion	1.00	1.00
Arm of the Study		
Intervention	1.22 (0.77, 1.93)	1.37 (0.81, 2.30)
Control	1.00	1.00

Table 2-B9. Hazard ratios for baseline characteristics for initiation of a moderate effectiveness method at baseline (n=399)

Characteristics	Unadjusted HR (95% CI)	Adjusted HR (95%CI)
Current Age	1.00 (0.95, 1.06)	0.98 (0.93, 1.04)
Race/ Ethnicity		
Black, Non-Hispanic	1.10 (0.85, 1.41)	1.02 (0.80, 1.30)
Hispanic	1.11 (0.86, 1.43)	1.08 (0.81, 1.43)
Asian/Others	0.67 (0.41, 2.05)	0.73 (0.43, 1.23)
White, Non-Hispanic	1.00	1.00
Insurance Status		
Medicaid/State insurance	0.86 (0.67, 1.10)	0.69 (0.49, 0.97)
No insurance	0.95 (0.72, 1.25)	0.99 (0.77, 1.27)
Private	1.00	1.00
Public Assistance		
Yes	1.11 (0.86, 1.45)	1.38 (0.98, 1.95)
No	1.00	1.00
Partner type		
None	1.76 (1.26, 2.46)	1.67 (1.19, 2.35)
Casual	2.10 (1.59, 2.76)	2.11 (1.54, 2.89)
Primary	1.00	1.00
Parity		
One child	1.38 (1.07, 1.80)	1.38 (1.01, 1.88)
Two or more children	1.07 (0.70, 1.64)	1.11 (0.68, 1.82)
No children	1.00	1.00
Number of Prior Abortions		
One or more	1.18 (0.93, 1.50)	1.06 (0.77, 1.47)
No abortion	1.00	1.00
Happiness about Pregnancy in the Next year		
Unhappy	0.81 (0.62, 1.06)	0.80 (0.61, 1.04)
Happy	1.00	1.00
Most Effective Method Used in 3 Months Prior to Study		
Hormonal	1.01 (0.78, 1.30)	1.13 (0.86, 1.48)
LARC	1.16 (0.64, 2.11)	1.11 (0.53, 2.33)
None/Condoms	1.00	1.00
Service at Enrollment Visit		
Family planning	0.76 (0.62, 0.94)	0.79 (0.61, 1.02)
Abortion	1.00	1.00
Arm of the Study		
Intervention	0.84 (0.67, 1.04)	0.86 (0.70, 1.04)
Control	1.00	1.00

Table 2-B10. Hazard ratios for baseline characteristics for initiation of a high effectiveness method at baseline (n=175)

<i>Characteristics</i>	<i>Unadjusted HR (95% CI)</i>	<i>Adjusted HR (95%CI)</i>
Current Age	0.90 (0.78, 1.03)	0.90 (0.74, 1.08)
Race/ Ethnicity		
Black, Non-Hispanic	1.41 (0.50, 3.93)	1.61 (0.47, 5.56)
Hispanic	1.35 (0.72, 2.53)	1.21 (0.51, 2.85)
Asian/Others	0.28 (0.04, 2.15)	0.30 (0.03, 2.82)
White, Non-Hispanic	1.00	1.00
Insurance Status		
Medicaid/State insurance	0.73 (0.28, 1.88)	0.78 (0.27, 2.24)
No insurance	1.47 (0.86, 2.54)	1.38 (0.83, 2.29)
Private	1.00	1.00
Public Assistance		
Yes	0.62 (0.30, 1.28)	0.69 (0.36, 1.33)
No	1.00	1.00
Partner type		
None	1.06 (0.50, 2.24)	1.04 (0.48, 2.29)
Casual	0.83 (0.17, 3.96)	0.78 (0.12, 4.99)
Primary	1.00	1.00
Parity		
One child	1.85 (0.96, 3.57)	1.28 (0.65, 2.53)
Two or more children	1.33 (0.78, 2.27)	1.21 (0.51, 2.88)
No children	1.00	1.00
Number of Prior Abortions		
One or more	0.56 (0.26, 1.21)	0.67 (0.33, 1.35)
No abortion	1.00	1.00
Happiness about Pregnancy in the Next year		
Unhappy	0.58 (0.31, 1.09)	0.72 (0.32, 1.59)
Happy	1.00	1.00
Most Effective Method Used in 3 Months Prior to Study		
Hormonal	0.85 (0.48, 1.51)	0.96 (0.47, 1.97)
LARC	2.56 (1.20, 5.47)	2.40 (1.10, 5.27)
None/Condoms	1.00	1.00
Service at Enrollment Visit		
Family planning	0.80 (0.44, 1.48)	0.61 (0.28, 1.35)
Abortion	1.00	1.00
Arm of the Study		
Intervention	0.81 (0.43, 1.52)	1.04 (0.50, 2.33)
Control	1.00	1.00

Chapter 5: Study Three

Title: Association between adolescents' experience of depression onset and teenage pregnancy; Does the timing of depression onset matter?

Abstract

Objective: To examine the independent association between timing of first depressive episode relative to age at sexual debut and first teenage pregnancy.

Methods: We used survival analysis to estimate the incidence rates of first teenage pregnancy among 1,016 girls 13-18 years old participating in the National Comorbidity Survey – Adolescent Supplement. We used age at first sexual intercourse to define the timing of depression onset as a four-level variables including no depression onset before pregnancy or end of the study, depression onset before age at first sex, depression onset at age at first sex, and depression onset after age at first sex and at or before age at first pregnancy or end of the study. We then applied Cox proportional hazards models to examine the independent association between the timing of depression onset the hazards of first teenage pregnancy. **Results:** We found that compared to girls with no depression onset during the study period (IR: 10.05/100 girls-year, 95% CI 8.96, 12.39), those with depression onset at age at first sex (IR: 17.33/100 girls-year, 95% CI 10.06, 29.84) had higher incidence of becoming pregnant, however this difference was not statistically significant. Examining the Cox proportional hazards models, we found that adolescent girls with depression onset in the same year as their sexual debut (HR: 2.73, 95% CI 1.07, 6.97) had a higher hazard of experiencing their first pregnancy than those with no

experience of depressive symptoms. **Conclusion:** Timing of first depressive episode relative to age at first sexual intercourse plays a role in teenage pregnancy. Future studies should further investigate the effect of depression on contraceptive behavior at the time of sexual debut.

Introduction

According to the latest national data from 2011, the pregnancy rate among adolescent girls 15-19 years old in the United States was 55 pregnancies per 1000 adolescent girls, a 21% decrease from 2008 (Finer & Zolna, 2016). Despite this decline, the rate of teenage pregnancy in the US is still higher than that in other developed countries and racial and regional disparities still exist (Amin, Decesare, Hans, & Roussos-Ross, 2017; Sedgh, Finer, Bankole, Eilers, & Singh, 2015; Department of Health and Human Services, 2016). Furthermore, 75% of pregnancies in this age group in 2011 were unintended (Finer & Zolna, 2016), which presents a great public health concern (Scally, 2002).

Teenage pregnancy poses unique challenges to adolescent mothers and their children. Adolescents are more likely to have shorter inter-pregnancy intervals than adult women (Katz et al., 2011) and thus more likely to experience repeated pregnancies before entering adulthood (Morbidity and Mortality Weekly Report, 2013). A systematic review of studies on teenage pregnancy indicate that approximately 19% and 40% of teens become pregnant again within 12 and 18 months, respectively (Meade & Ickovics, 2005). In addition to repeat pregnancy, pregnancies carried to term during adolescence are associated with adverse outcomes for the teen mother including pregnancy complications, less educational attainment, lower employment opportunities, and perinatal depression (Bahk, Yun, Kim, & Khang, 2015; Chang, Schwarz, Douglas, & Horon, 2009; Chiquero, 2010; Ferre, Gerstenbluth, Rossi, & Triunfo, 2013; Gipson, Koenig, & Hindin, 2008; Lanzi, Bert, & Jacobs, 2009). Children born to teenage mothers are also at a higher risk for being

born preterm, having low birth weight, developing behavioral problems, having academic disadvantages, being maltreated, and becoming teen mothers (Chen et al., 2007; Furstenberg, Brooks-Gunn, & Morgan, 1987; Langille, 2007).

One of the psychological factors that has been shown to be associated with adolescent behaviors leading to pregnancy is depression. Depression is associated with a younger age at the onset of sexual experience, non-use or inconsistent use of contraception, low compliance with the contraceptive methods, alcohol consumption before having sex, and ambivalence about becoming pregnant—all of which may place adolescent girls at a higher risk for experiencing teenage pregnancy (Brooks, Harris, Thrall, & Woods, 2002; DiClemente et al, 2001; Hall et al, 2014; Lehrer et al., 2006; Panova, Kulikov, Berchtold, & Suris, 2016; Wellings et al., 2013; Zink, Shireman, Ho, & Buchanan, 2002).

On the national level, the lifetime and 12-month prevalence of major depressive disorder (MDD) among adolescent girls aged 13-18 years are 15.9% and 10.7% respectively (Avenevoli, Swendesen, He, Burstein, & Merikangas, 2015; National Comorbidity Survey, Appendix Table 2, N.D.). More strikingly, approximately 23% of girls 15-16 years have already had a lifetime experience of depression (Kessler et al., 1998).

A body of research has focused on the effect of depression on pregnancy among adolescent girls, however, the findings are inconsistent (Bennett, Culhane, McCollum, & Elo, 2006; Hall, Richards, & Harris, 2017; James-Hawkins, Denardo, Blalock, & Mollborn, 2014; Kessler et al., 1997; Mollborn & Morningstar, 2009; Takahashi et al., 2012; Tenkku, Flick, Homan, Loveland Cook, Campbell &

McSweeney, 2009). One study found that depressive symptoms during adolescence were significantly associated with an unintended first pregnancy in young adulthood (James-Hawkins, Denardo, Blalock, & Mollborn, 2014). Similarly, several other studies found that depressive symptoms were associated with a greater risk of pregnancy among teenage girls (Hall, Richards, & Harris, 2017; Kessler et al., 1997; Takahashi et al., 2012). In contrast, two studies found no association between depression and pregnancy in adolescent girls (Bennett et al., 2006; Tenkku et al., 2009).

Fifty percent of adolescents experiencing a first depressive episode experience an episode within the next two years and 75% within the next five years (Garland & Solomons, 2002). Furthermore, for many girls, adolescence marks the initiation of sexual intercourse (Finer & Philbin, 2014), which can place them at risk for teenage pregnancy. Since depression is associated with a younger age at first sex, to elucidate the relationship between depression and subsequent pregnancy during adolescence, the timing of the first depressive episode with respect to age at first sex may be an important factor to consider.

Present study

The current study investigated the association between depression onset and subsequent teenage pregnancy using the National Comorbidity Survey Adolescent Supplement (NCS-A), which includes estimates of the DSM-IV in a sample of nationally representative adolescent girls. While prior studies investigating the association between depression and teenage pregnancy have often treated age at first sex merely as a covariate and have controlled for it in the regression model, we will

use information on age at first sex to define the timing of the first depressive episode by considering when the onset occurred relative to age at first sex. Therefore, the objective of this study is to examine the association between a first depressive episode occurring before, at, or after age at first sex and the likelihood of having a teenage pregnancy among girls aged 13-18 years old.

Material and Methods

Data source and study population

NCS-A is a nationally representative cross-sectional study of 10,123 adolescents aged 13-18 years in the United States, designed to estimate the lifetime and current prevalence, onset age, course of development, and comorbidity of DSM-IV disorders, and to identify risk and protective factors associated with each disorder. The core diagnostic interviews are based on the modified version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI), which is a fully structured diagnostic interview designed for use by trained interviewers (Merikangas, Avenevoli, Costello, Koretz, & Kessler, 2009). Other behavioral factors and likely correlates of mental disorders were also assessed. A detailed description of the background, measures, and study design of NCS-A is published elsewhere (Kessler et al., 2009a; Kessler et al., 2009b). Briefly, between February 2001 and January 2004, adolescents from household and school-based samples were interviewed by professional interviewers using computer assisted personal interviews (CAPI). Access to the data was approved by the Interuniversity Consortium for

Political and Social Research and Institutional Review Board approval for this study was obtained by the University of Maryland, College Park.

Because the focus of this study is the first experience of teenage pregnancy, our study population was restricted to female participants who reported ever having sex after the age of 10 (n=1131).

Measures

Outcome: Incidence of First Teenage Pregnancy

Incidence of first teenage pregnancy during the study period was defined based on answers to the following questions from the survey by girls with sexual intercourse onset after the age of 10: 1) how old were you when you had your first child, and 2) how old were you the first time you had a miscarriage, stillbirth or abortion. A continuous variable for the age at first pregnancy was created using 1) the age at first childbirth if the adolescents had no miscarriages, stillbirths, or abortions; 2) the age at first miscarriage, stillbirth, or abortion if the adolescents had no childbirths; and 3) the minimum age for girls who had reported an age for both childbirth and miscarriage, stillbirth, or abortion. Adolescents reporting an age for childbirth, miscarriage, stillbirth, or abortion younger than their age at the interview (end of the study) were classified as having experienced a teenage pregnancy. Adolescents who did not report an age for childbirth, miscarriage, still birth, or abortion until the interview date (end of the study) were right censored.

Exposure: Timing of First Depressive Episode

First depressive episode was defined with respect to adolescents' age at sexual debut and based on the age at either first minor or major depressive episodes. Using

this information, we classified participants into four depression categories including: 1) no depressive episode onset before pregnancy or at the time of interview if not pregnant by interview (end of the study), 2) depressive episode onset before age at first sex, 3) depressive episode onset at age at first sex, and 4) depressive episode onset after age at first sex and at or before age at first pregnancy (if pregnant by interview) or age at interview (if not pregnant by interview).

Covariates

Based on the literature, we examined the effects of the following baseline characteristics which have been shown to be associated with teenage pregnancy (Dehlendorf, Rodriguez, Levy, Borrero, & Sterinauer, 2010; Hall et al., 2017; World Health Organization, 2014): race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Others); marital status (married/cohabitating vs. never married); regional residency (urban, rural, other urban); age at first sex; participants' parental education (less than high school, high school graduate, some college, college graduate or higher); and participants' mothers' age at the time of giving birth to the participants (greater than 19 vs. 19 or less).

Analyses

We compared pregnant and non-pregnant participants on baseline covariates and timing of depression onset using weighted chi-square tests for categorical variables. The incidence rate of teenage pregnancy during study period was determined by dividing the number of adolescent girls who became pregnant during

the study period by the total number of person-years accumulated in the study population.

To examine the relationship between timing of first depressive episode and the hazard of first teenage pregnancy during the study period, we applied Cox proportional hazards models to account for censoring of participants who had not become pregnant by the end of study. We reconstructed time to pregnancy based on information on adolescents' age at first sexual intercourse. Age at first sexual intercourse was considered as the origin for all participants and time was measured from that point on to the end of study which was the age at first pregnancy for those who became pregnant, or to the current age at interview if not pregnant by interview (end of study). We examined the association between timing of first depressive episode and the hazard of experiencing first teenage pregnancy using unadjusted and adjusted Cox proportional hazards models. Specifically, hazard ratios and 95% confidence intervals were computed using weighted proportional hazard ratios. Adjusted models accounted for all covariates that have shown to be associated with the teenage pregnancy based on the literature (Dehlendorf, et al., 2010; Hall et al., 2017; World Health Organization, 2014) or those that were associated with either the teenage pregnancy or depression status in our sample at $p < 0.05$.

We incorporated complex survey weights with proper cluster and strata variables according to the NCS-A guidelines to account for national representativeness of the sample (Kessler et al., 2009; Lee-Winn, Reinblatt, Mojtabai, & Mendelson, 2016).

We also conducted a supplementary analysis. We repeated the survival analysis for those who experienced the first depressive episode after the first sexual intercourse and in the same year as the first pregnancy (n=3). While in the main coding of depression, we classified those who had a first depressive episode at the same age as their first pregnancy in the last category as having first depressive episode after age at first sex and *at* or *before* pregnancy, in the supplementary analysis, we assumed that for these three adolescents the first depressive episode occurred *after* pregnancy, and thus classified them in the first depression category as having no depression. All analyses were conducted in STATA 14.

Results

From 1,016 adolescent girls in the weighted analytic sample, 140 experienced a first pregnancy during the study period. The total time at risk to the first teenage pregnancy was 1,324.276 person-years, with the median at risk time of one year ranging from 1 to 6 years. Table 3-1 presents the baseline characteristics of the entire sample and differences by pregnancy status. The mean age of participants at the time of the interview was 16.2 (SD= 0.11). The majority of participants (66%) identified as white non-Hispanic girls, were never married (96%), and resided in metropolitan areas (49%). Approximately 53% of teenagers had parents with a high school degree or less and 20% reported being born to a teenage mother. Participants' average age at sexual debut was 14.9 (SD= 0.07) ranging from 11-18 years old. Among participants with an experience of first pregnancy, the mean age at first pregnancy was 15.54 (SD= 0.16). Most participants did not have a depressive episode (70%), while 23% had their first depressive episode before the age at first sex, 4.4% had a first

depressive episode at age at first sex, and 2.3% had their first depressive episode after age at their first sexual intercourse but before age at first pregnancy or before the interview for those with no pregnancy experience. For those who had had a first depressive episode during the study period (n=301), the mean age for the first depressive episode was 11.90 (SD= 0.26).

Adolescent girls with an experience of a first pregnancy were more likely to be from a black non-Hispanic or Hispanic background (45.52% vs. 29.57%, $p=0.005$), were more likely to be married (14.50% vs. 2.06%, $p<0.001$), and in the lowest poverty index ration (30.61% vs. 12.09%, $p=0.002$) compared to their non-pregnant counterparts. Although previous literature has shown that being born to a teenage mother is a strong predictor for experiencing teenage pregnancy (Langille, 2007), in our sample, this was not the case ($p=0.98$).

Table 3-2 represents the differences in baseline characteristics by depression onset categories. Participants in the four depression groups were only marginally different from each other with respect to maternal age at the time of giving birth to the teenage participants ($p=0.064$).

The overall incidence rate of teenage pregnancy was 10.57/100 person-years (95% CI 8.96, 12.48). The incidence rate of teenage pregnancy was higher for girls experiencing first depressive episode at age at first sex (17.33/100 person-years, 95% CI 10.06, 29.84) than for those with no depression onset (10.05/100 person-years, 95% CI 8.16, 12.39) but this difference was not statistically significant. The incidence rate of teenage pregnancy was 6.66/100 person-years (95% CI 5.00, 8.86) for white non-Hispanic girls and it was significantly lower than in black, non-Hispanic girls

(IR: 18.54/100 person-years, 95% CI 14.09, 24.40). The incidence rate of teenage pregnancy did not differ between pregnant and non-pregnant girls based on other baseline characteristics (Table 3-3).

The results of the crude and the adjusted Cox proportional hazard models for all covariates are illustrated in Table 3-4. In the unadjusted models, participants whose first depressive episode was in the same year as their first sexual intercourse had 2.53 times significantly higher hazard of becoming pregnant compared to those with no depressive episode onset (95% CI: 1.08, 5.96, $p=0.034$). There were no differences in hazard of pregnancy among adolescent girls who had a depression onset before or after the age at first sex compared to those with no depressive episodes (p -values >0.1).

In the model adjusted for all covariates, the hazard of first teenage pregnancy remained significantly higher for girls with depression onset at the age of first sexual intercourse (aHR=2.65, 95% CI: 1.07, 6.57, $p=0.04$) than non-depressed girls. In addition to depression status, black, non-Hispanic girls (aHR=1.94, 95% CI: 1.15, 3.27, $p=0.01$), and Hispanic girls (aHR= 1.77, 95% CI: 1.02, 3.09, $p=0.04$) had a higher hazard of experiencing first teenage pregnancy than their white, non-Hispanic counterparts. The hazard of teenage pregnancy decreased by 74% for non-married girls compared to those married/cohabitating (aHR=0.26, 95% CI: 0.13, 0.53, $p<0.001$).

In the supplementary analysis, we reran the Cox proportional hazard models with the assumption that for girls who experienced their first depressive episode in the same year as first pregnancy, depression onset occurred as the result of pregnancy

and not as a predictor of pregnancy. Therefore, we coded these girls as not having a depression onset (n=3) during study period. The results were similar to the main analysis. In the adjusted model, adolescents with the first depressive episode at age at first sexual experience had 2.64 times higher hazard of becoming pregnant compared to their non-depressed counterparts (95% CI: 1.04, 6.73, p=0.041).

Discussion

Using a nationally representative sample of adolescent girls and time-to-event analysis, we investigated the association between the timing of depression onset relative to age at first sexual intercourse and the experience of first teenage pregnancy. We found that compared to those with no depression onset, girls whose depression onset occurred in the same years as their sexual debut were at an increased hazard of experiencing their first pregnancy during the study period.

Initiation of sexual intercourse in adolescents marks an important event in the young women's lives by placing them at risk for pregnancy. This is also the time when girls need to start thinking about their contraceptive behaviors and reproductive decisions. Although we did not examine the mechanisms by which depression onset at age at first sexual intercourse may lead to an increased risk for pregnancy, two explanations can be speculated. First, it is possible that for girls who experienced depression onset during the same year as their sexual debut, experiencing the depressive symptoms around the time of initiating sex may have directly led these girls to non-use or inconsistent use of a contraceptive method. Previous research has shown that teenage girls experiencing depression are less likely to use contraception or use a less effective method (Berenson, Breitkopf, & Wu, 2003; DiClemente et al.,

2001; Francis et al., 2015; Hall et al., 2014; Hall et al., 2013a; Morrison et al., 2016).

Second, they may have initiated sexual intercourse as a way to cope with their depression. In this scenario, engaging in sexual intercourse as a coping mechanism may mediate the relationship between depression and contraceptive behaviors, placing the girls at a higher risk for pregnancy. Future research therefore should further examine these relationships.

This study offers a unique contribution to the existing body of literature in adolescent health. While previous studies have considered adolescents' depression status at any point in time before occurrence of first pregnancy and have adjusted for the age at first sex in the regression model (Bennett, Culhane, McCollum, Elo, 2006; Hall, Richards, & Harris, 2017; Kessler et al., 1997; Takahashi et al., 2012), ours is the first to incorporate age at first sex in operationalization of the depression exposure by defining the timing of depression onset before, at, or after age at first sex and estimating the time to first pregnancy using Cox proportional hazards models. Considering in the United States, on average, young women experience sexual debut at some point during adolescence period (Finer & Philbin, 2014), and considering the association between depression and adolescents' risky behaviors including unprotected sex and substance use before initiating sexual intercourse (Brooks, Harris, Thrall, & Woods, 2002; Hall, Moreau, Trussell, & Barber, 2013; Lehrer, Shrier, Gortmaker, & Buka, 2006), having information on *when* experiencing depression onset may have the most impact on adolescent girl's risk for pregnancy can provide a more insightful understanding of how to prevent the negative outcomes of teenage pregnancy.

The current study uses the data from the NCS-A, which is the only available nationally representative dataset with rich information on DSM-IV disorders including major and minor depressive disorders and their onset. The use of the CIDI depression diagnosis instrument in this survey eliminates limitations that depression-screening tools may carry. Depressive symptoms' screening instruments have only a limited validity in predicting DSM-IV depressive disorders, whereas CIDI is a validated depression diagnostic instrument (Andrews & Peters, 1998; Henkel, Mergl, Kohnen, Maier, Moller, & Hegerl, 2003).

In addition to first depressive episode, black non-Hispanic (HR=2.00, CI=1.22, 3.28, $p=0.007$) and Hispanic adolescents (HR=1.76, CI=1.00, 3.09, $p=0.049$) had increased hazards of experiencing first pregnancy than white non-Hispanic girls during the study period. Being born to a teenage mother has been shown to be one of the strong predictors of teenage pregnancy, however, in our sample there was no association between this covariate and teenage pregnancy among the adolescents ($p>0.1$).

This study has some limitations that need to be considered when interpreting the findings. First, proximity of experiencing first depressive episode with respect to age at first sex was measured based on years. Therefore, for those who experienced depression onset in the same year as their sexual debut we do not know which one came first. Having information on the month of depression onset and sexual debut could help distinguish between girls who experienced depression onset first followed by their sexual debut and those who had their sexual debut first followed by depression onset. Despite this limitation, we do know depression onset around the

same time as sexual initiation was associated with a higher hazard of first teenage pregnancy.

Second, although 75% of teenage pregnancies in the US are unintended (Finer & Zolna, 2016), and past research has shown depressive symptoms in adolescents to be associated with a feeling of ambivalence about pregnancy (Francis et al., 2015), young women's pregnancy intentions have not been measured in this study and therefore we do not know whether the pregnancies that occurred during the study period were unwanted or mistimed.

Third, in this study we operationalized teenage pregnancy based on the participant's self-reported age at which first childbirth and/or first miscarriage, stillbirth, or abortion occurred. However, knowing the time of conception (i.e. the date of last period) would enable us to determine the age at first pregnancy more accurately for participants in the study. Future studies can benefit from a prospective design in which participants are followed over time and information on their pregnancy status is collected through the usage of biomarkers or alternative ways that relying on participants' memory and recall of the event.

Fourth, in the current study we only used first depressive episode as the exposure and therefore we were unable to determine whether findings would be different for participants with multiple depressive episodes before pregnancy (if pregnant) or the interview date if not pregnant. Since research has shown that approximately half of adolescents experiencing a first depressive episode experience recurrence of depression the next years (Garland & Solomons, 2002), future studies

should examine whether experiencing multiple depressive episodes over time versus one time could change the risk of pregnancy during adolescence.

Finally, we did not measure adolescents' contraceptive behaviors in this study. Therefore, we cannot confirm whether or not depressed girls used contraception at the time of sexual intercourse that led to their pregnancy. Having information on contraceptive use of depressed adolescent girls at the time of sex could provide a better understanding of how depression may influence adolescent girls' decision surrounding contraception and pregnancy. Future studies examining the effect of depression on teenage pregnancy should, therefore, investigate whether factors such as choice and patterns of contraceptive method use differ among depressed girls who are sexually active compared to non-depressed girls.

Despite the limitations, the findings of this study indicate that not only presence or absence of depression during adolescence but *when* it occurs relative to sexual debut can influence first teenage pregnancy. These findings have implications for adolescents' reproductive health by providing evidence for the significance of mental health on adolescents' sexual and reproductive decisions. Therefore, these findings should be taken into account when addressing the issue of teenage pregnancy and mental health in adolescents.

Given many girls become sexually active during adolescence, they should be fully educated about all available options and their effectiveness in pregnancy prevention. Even though long acting reversible contraceptives (LARC) are currently the most effective contraceptive methods for pregnancy prevention (Trussell, 2011), they have a low rate of usage among teenagers (Romero et al., 2015). This could be in

part attributable to factors such as teens' lack of knowledge about the method and high insertion costs. Therefore, healthcare providers should encourage the use of LARC among all adolescent girls through educating them on the benefits of LARC methods and increasing their access to these methods by providing on-site, one-step, and free insertion of the devices. Furthermore, adolescents diagnosed with depression should be encouraged to delay sexual initiation until they have received treatment especially if they are on using any contraceptive methods. Furthermore, all children and teenagers should be educated on how to recognize the symptoms of mental health conditions such as depression in themselves and should be encouraged to inform their parents, school personnel, or their healthcare provider of their feelings. These types of practices can help all teenage girls especially who are experiencing depression to have safer sexual encounters and prevent becoming pregnant.

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Tables

Table 3-1. Baseline characteristics of the sample by pregnancy outcome

<i>Teenagers Characteristics</i>	<i>n</i>	<i>Weighted %</i>	<i>Pregnancy Status, Weighted %</i>		<i>P-value</i>
<i>Total</i>	<i>1025</i>		<i>Pregnant (%)</i>	<i>Censored (%)</i>	
Depression Onset Status					0.038
No onset before pregnancy or end of study	717	70.33	59.33	71.90	
Onset before first sex	216	22.98	27.37	22.35	
Onset at first sex	55	4.40	9.87	3.62	
Onset after first sex at or before pregnancy or end of study	37	2.29	3.43	2.13	
Mean Current Age (SD)	1025	16.20 (0.11, 13-18)	16.63 (0.16)	16.13 (0.12)	0.014
Race/ Ethnicity					0.005
White, Non-Hispanic	559	65.88	50.73	68.05	
Black, Non-Hispanic	228	19.17	27.74	17.94	
Hispanic	191	12.40	17.78	11.63	
Others	47	2.55	3.75	2.38	
Marital Status					<0.001
Married/cohabitating	46	3.62	14.50	2.06	
Never married	979	96.38	85.50	97.94	
Poverty Index Ratio					0.002
<1.5	178	14.41	30.61	12.09	
1.5 - ≤3.0	229	22.80	18.55	23.40	
3.0 - ≤6.0	308	31.99	25.24	32.96	
>6.0	310	30.80	25.59	31.54	
Residential Region					0.830
Metropolitan	454	49.01	48.21	49.12	
Rural	247	16.08	14.62	16.29	
Other	324	34.91	37.16	34.58	
Mean Age at First Sex (SD)	1025	14.88 (0.07, 11-18)	14.48 (0.19)	14.94 (0.08)	0.023
First Pregnancy Status			-----		

Yes	141	12.53			
No	884	87.47			
Mean Age at First Pregnancy^a (SD)	141	15.54 (0.16, 13-18)	15.54 (0.16)		-----
Mean Age at Depressive Onset^b (SD)	313	11.90 (0.26, 4-17)	11.47 (0.64)	11.99 (0.28)	0.459
<i>Parental Characteristics</i>					
Parental Education					0.391
Less than high school	168	13.37	18.06	12.70	
High school graduate	380	39.17	44.56	38.39	
Some college	233	23.32	18.37	24.03	
College graduate or more	243	24.14	19.01	24.88	
Mothers' Age at Time of Giving Birth to participants					0.977
≤19	197	20.08	20.54	20.02	
>19	828	79.92	79.46	79.98	

Note. a: n=127, b: n=301

Table 3-2. Bivariate analysis between timing of first depressive episode and covariates (Weighted N=1016)

<i>Variables</i>	<i>First Depressive Episode Timing</i>				<i>P-value</i>
	No onset 100%	Onset before 1st sex (%)	Onset at 1st sex (%)	Onset after 1st sex (%)	
Teenager Characteristics					
Race and Ethnicity					0.108
White, Non-Hispanic	65.84	70.17	62.19	31.12	
Black, Non-Hispanic	20.41	11.33	20.58	56.83	
Hispanic	11.33	15.74	14.26	8.48	
Others	2.42	2.76	2.97	3.56	
Marital Status					0.491
Married/cohabitating	3.55	4.59	0.53	1.88	
Never married	96.45	95.41	99.47	98.12	
Poverty Index Ratio					0.458
<1.5	14.90	11.02	26.54	10.41	
1.5 - ≤3.0	24.10	19.28	14.51	33.81	
3.0 - ≤6.0	31.75	35.10	22.17	26.88	
>6.0	29.24	34.60	36.78	28.89	
Residential Region					0.116
Metropolitan	48.49	54.93	26.27	49.21	
Rural	18.34	10.08	14.76	9.58	
Other	33.17	34.99	58.96	41.22	
Mean Age at First Sex (SD)	15.69 (0.23)	15.33 (0.25)	15.11 (0.32)	15.75 (0.40)	0.215
Parental Characteristics					
Parental Education					0.124
Less than high school	14.35	9.54	14.57	19.40	
High school graduate	42.33	33.02	24.53	31.91	
Some college	19.33	32.35	39.30	24.63	
College graduate or more	23.99	25.09	21.60	24.07	
Age Mother Gave Birth to Teenager					0.064
≤19	17.48	30.55	7.68	18.98	
>19	82.52	69.45	92.32	81.02	

Table 3-3. Incidence rates for first teenage pregnancy

<i>Characteristics</i>	<i>Number of pregnant teenagers</i>	<i>Girls-year</i>	<i>Incidence rate* (95% CI)</i>
Overall	140	1324.28	10.57 (8.96, 12.48)
Depression Onset status			
No onset before pregnancy or end of the study	88	875.20	10.05 (8.16, 12.39)
Onset before first sex	31	278.06	11.15 (7.84, 15.85)
Onset at first sex	13	75.02	17.33 (10.06, 29.84)
Onset after first sex & at or before pregnancy or end of the study	8	96.00	8.33 (4.17, 16.66)
Race/Ethnicity			
White, Non-Hispanic	47	706.16	6.66 (5.00, 8.86)
Black, Non-Hispanic	51	275.07	18.54 (14.09, 24.40)
Hispanic	33	265.04	12.45 (8.85, 17.51)
Others	9	78.01	11.54 (6.00, 22.17)
Marital Status			
Married/Cohabiting	20	77.01	25.97 (16.76, 40.25)
Never married	120	1247.27	9.62 (8.04, 11.51)
Poverty Index Ratio			
<1.5	43	223.04	19.28 (14.30, 25.99)
1.5 - ≤3.0	30	312.06	9.61 (6.72, 13.75)
3.0 - ≤6.0	25	403.09	6.20 (4.19, 9.18)
>6.0	42	386.08	10.88 (8.04, 14.72)
Residential Region			
Metropolitan	71	598.12	11.87 (9.41, 14.98)
Rural	24	291.07	8.24 (5.53, 12.30)
Other	45	435.08	10.34 (7.72, 13.85)
Parental Education			
Less than high school	33	223.04	14.80 (10.52, 20.81)
High school graduate	55	490.10	11.22 (8.62, 14.62)
Some college	29	329.05	8.81 (6.12, 12.68)
College graduate or more	23	282.07	8.15 (5.42, 12.27)
Mothers' Age at Time of Giving Birth to Teens			
≤19	33	233.06	14.16 (10.07, 19.92)
>19	107	1091.22	9.81 (8.11, 11.85)

*Per 100 girl-year

Table 3-4. The unadjusted and adjusted hazard ratios between the timing of first depressive episode and first pregnancy (n=1016)

Variables	Unadjusted HR (95% CI)	Adjusted HR* (95%CI)
Timing of Depression Onset		
Onset before 1 st sex	1.45 (0.84, 2.49)	1.51 (0.81, 2.80)
Onset at 1 st sex	2.53 (1.08, 5.96)	2.73 (1.07, 6.97)
Onset after 1 st sex before 1 st pregnancy or end of the study	1.01 (0.38, 2.70)	1.06 (0.35, 3.26)
No onset before 1 st pregnancy or end of the study	1.00	1.00
Race and Ethnicity		
Black, Non-Hispanic	1.85 (1.21, 2.83)	2.00 (1.22, 3.28)
Hispanic	1.92 (1.30, 2.83)	1.76 (1.00, 3.09)
Others	1.63 (0.55, 4.85)	1.36 (0.44, 4.19)
White, Non-Hispanic	1.00	1.00
Marital Status		
Never married	0.32 (0.18, 0.57)	0.26 (0.13, 0.51)
Married/cohabiting	1.00	1.00
Poverty Index Ratio		
<1.5	2.34 (1.31, 4.18)	1.80 (0.90, 3.59)
1.5 - ≤3.0	0.89 (0.44, 1.79)	0.83 (0.42, 1.64)
3.0 - ≤6.0	0.84 (0.44, 1.60)	0.84 (0.41, 1.69)
>6.0	1.00	1.00
Residential Region		
Rural	0.84 (0.51, 1.40)	1.19 (0.65, 2.15)
Other	0.93 (0.62, 1.39)	1.09 (0.74, 1.61)
Metropolitan	1.00	1.00
Age at First Sex		
	0.99 (0.83, 1.20)	1.08 (0.87, 1.33)
Parental Education		
Less than high school	1.46 (0.59, 3.64)	0.96 (0.37, 2.49)
High school graduate	1.40 (0.58, 3.31)	1.19 (0.46, 3.07)
Some college	0.97 (0.32, 2.96)	0.71 (0.22, 2.27)
College graduate or higher	1.00	1.00
Age Mother Gave Birth to Teenager		
≤19	1.13 (0.61, 2.09)	0.99 (0.55, 1.79)
>19	1.00	1.00

* The regression model was adjusted for all baseline characteristics

Chapter 6: Discussion

The overarching objective of this interdisciplinary dissertation was to investigate the independent association between depression (independent variable) and women's contraceptive behaviors, and teenage pregnancy (dependent variables). Each study explored a specific aspect of this relationship including contraceptive method choice, contraceptive method discontinuation, and teenage pregnancy in three different populations of reproductive age women shown to have an elevated risk for unintended pregnancies. Specifically in the first study, the association between pre-abortion depressive symptoms and post-abortion choice of contraceptive method was examined among a sample of women seeking abortion services. Women seeking abortion services are at a higher risk for future abortions due to an unintended pregnancy compared to those seeking other reproductive health services (Upadhyay et al., 2012). In the second study, the sample consisted of low-income women seeking services at community reproductive health clinics. Women with lower income are more likely to have unintended pregnancies than women with higher incomes (Finer & Zolna, 2016; Jones & Kavanaugh, 2011). Lastly, the third study used a sample of sexually active adolescent girls and since the prevalence of unintended pregnancies among adolescent girls is high investigating the effects of depression on pregnancy was warranted. Together these three studies provide empirical support for the theoretical model proposed in the introduction (Chapter 1) on mechanisms through which depression may influence women's contraceptive behaviors and teenage pregnancy.

What follows is a brief summary of the main findings from the three studies, the contribution of the findings to the literature, and how the findings can be explained by the proposed theoretical model, limitations and suggestions for future research, and the overall implications for public health and practice.

Summary of Major Findings

The key findings from the three studies in this dissertation are in line with the hypothesis that depression—or depressive symptoms—would be associated with women’s contraceptive behaviors and teenage pregnancy. Specifically, we found that 1) more pre-abortion depressive symptoms were associated with choosing a less effective rather than a moderately or a highly effective contraceptive method; 2) experiencing baseline and history of elevated depressive symptoms was associated with a higher likelihood of discontinuation for specific contraceptive methods but these associations did not reach statistical significance when examining all contraceptive methods combined; and 3) depression onset at the same age as sexual debut was associated with a higher hazard of teenage pregnancy. In addition to depression, we found partner characteristics including the number of sexual partners in the past and the type of sexual partner (primary, casual, or no partner) to be significantly associated with women’s contraceptive behaviors.

These findings further emphasize the critical role depression plays in reproductive decision making for women at high risk for unintended pregnancy.

Contribution to the Literature

This research adds to the existing but limited body of literature on how depression influences women's contraceptive behaviors and teenage pregnancy in several ways. First, this dissertation enriches the existing knowledge in the field by emphasizing that timing of depression may play a critical role in women's contraceptive behaviors and reproductive decision-making. Specifically, the findings of this study indicate that not only the *presence or the absence* of depression or depressive symptoms but also when they exhibit themselves (their *timing*) in the course of women's lives, can predict how women make decisions regarding contraception and pregnancy. For instance, as illustrated in the second study of this dissertation, the effect of elevated depressive symptoms occurring only once in time (either at the baseline of the study or in the past only) versus occurring both in the past and at the baseline of the study (which could be more indicative of chronic depression) was associated with a higher likelihood of contraception discontinuation. Similarly, as shown in the third study, hazard of experiencing teenage pregnancy increased for girls when depression onset occurred *at* the same age as their sexual debut, compared to their non-depressed counterparts.

Second, only a few studies have examined women's choice of contraceptive method in relation to depressive symptoms. The current study is the second study to investigate the association between pre-abortion depressive symptoms and women's contraceptive choice after they have undergone contraceptive counseling. Compared to the one previously performed study among women seeking abortion services, the present study incorporated a greater number of covariates shown to be associated with

women's contraceptive choice or depressive symptoms in an effort to reduce the possible confounding effect of those factors on the relationship, and in turn draw a more comprehensive picture of the relationship between depression and women's contraceptive choice.

Third, this study is one of the only studies to date to examine the relationship between elevated depressive symptoms and women's contraception discontinuation, incorporating two depression measures, including baseline level of depressive symptoms at the time of method initiation, and history of elevated depressive symptoms, in the operationalization of the exposure. This allowed for differentiating the effect of elevated depressive symptoms occurring only once in time versus occurring at least twice (which is more indicative of chronic depression) on contraceptive method continuation.

Finally, from a methodological perspective, this dissertation contributes to the literature by using time-to-event analysis to assess the association between depression, women's contraceptive discontinuation and teenage pregnancy (Chapters 4 and 5). Unlike ordinary logistic regression, time-to-event analyses reflect the time until an event of interest occurs. In addition to providing relative effect estimates, we used time-to-event analysis to predict survival time for contraceptive discontinuation and teenage pregnancy among women with and without depression. Finally, in the presence of censoring—a phenomenon where survival time is unknown due to loss to follow-up—ordinary logistic regression analyses provide biased estimates of the events of interest. Using time-to-event analysis, we accounted for censoring by modeling the probability of contraceptive discontinuation or teenage pregnancy

conditional on participants' survival over time, utilizing information on censored individuals only while they are at risk for the events of interest (George, Seals, & Aban, 2014). These strengths optimize the utilization of available information on time to contraceptive discontinuation or teenage pregnancy in relation to depression status and provide an insight into the role of mental health in teenage reproductive health.

Interpretation of the Findings using the Theoretical Model

Although this study did not examine the mechanisms through which depression or depressive symptoms may influence women's contraceptive behaviors and reproductive decision-making, the major findings of this dissertation provide indirect support for the proposed theoretical model and the findings can be explained by the theoretical mechanism. Depressive mood triggered by different environmental stressors may interrupt the person's ability to adapt to adverse situations. When the individual is unable to reserve such an emotional state, it may lead to increased dysphoria and in turn negatively influence the cognitive, emotional, and behavioral aspects of the individual's life (Lewinsohn, Rohde, & Seeley, 1998). This state may manifest itself through symptoms such as low motivation to perform different tasks, low sense of control over future life events, low sense of self-efficacy to care for oneself, and focusing on the negative aspect of things all of which may influence the decision-making process (Joornann & Vanderlind, 2014; Minnix, Blalock, Marani, Prokhaorov, & Cinciripini, 2011). Therefore, the decision on which method of contraception to choose may be hampered in women experiencing these depressive symptoms compared to non-depressed women. Lower motivation may inhibit women from adequately maintaining a contraceptive regimen, especially when it requires

more personal effort to maintain the regimen (e.g. remembering to take a pill every day, going to the provider to get a shot). In addition, depressed women focus on the negative perceived side effects of contraception, which may further influence the decision surrounding contraceptive method choice and continuation. Women with elevated depressive symptoms have been shown to focus more on the negative perceived side effects of hormonal contraceptive methods such as weight gain and mood changes (Hall et al., 2012). This may mean that the contraceptive effectiveness is not prioritized when women face the decision of contraceptive continuation. These speculations were confirmed by the findings from our studies where women with more depressive symptoms were more likely to choose a method of low effectiveness and the continuation rates of specific methods decreased in women with elevated depressive symptoms. These were indeed methods that require additional effort to maintain compared to other methods (patch and Depot-Provera shot in the adjusted models, and the ring and the pill in the unadjusted models). Similarly, depressed adolescent girls may experience low self-efficacy and low motivation in their contraceptive behaviors and in turn become ambivalent towards becoming pregnant, which may lead them to non-use or inconsistent use of contraception at the time of sexual intercourse onset (Carvajal et al., 2014; Francis et al., 2015). Our findings also confirmed these speculations.

As mentioned previously, of all the covariates examined in the three studies partner characteristics were independent predictors of women's contraceptive choice and discontinuation. These findings suggest that women's choice of contraception or their decision to continue their contraceptive method could be influenced by

characteristics of their relationship with their sexual partner. Women who have multiple sexual partners may choose to use condoms as a measure to protect themselves from not only an unintended pregnancy but also sexually transmitted infections. Similarly, women who have no sexual partner or a casual sexual partner may discontinue their contraceptive method at a higher rate than those with a primary partner as a result of not having sexual intercourse on a regular basis and not anticipating engaging in sexual activity. Therefore, the presence or absence of a sexual partner and the nature of women's relationship with their partners seems to be related to women's contraceptive behaviors independent of women's mental health.

Limitations and Future Research Directions

There are also some limitations to this dissertation research that need to be addressed. In the first study (Chapter 3), we were unable to distinguish between transient versus chronic states of depression. Measuring depressive symptoms at a single point in time makes it difficult to distinguish between transient depressive state elevated by factors related to the situation versus a more chronic depressive state independent of the woman's feeling at the time of survey. In the second study (Chapter 4), we addressed this limitation by using information on current and past depressive symptoms to create the depression variable to be able to distinguish between women's experience of depression in the past only, in the present only, or both in the past and the present (indicative of a more chronic condition). In this design the information about the past experience of depressive symptoms was collected retrospectively which could be susceptible to recall bias. Additionally, there was no information on whether women experienced more depressive symptoms in

between the past and present times. Future studies, therefore, should consider a longitudinal design where women are followed overtime and their depressive symptoms are measured not only at the clinic before undergoing an abortion procedure or contraception initiation but also before they experience pregnancy or leave the reproductive clinic. Such information can help establish a mental health timeline for women and better understand the nature of depression and its influence on their contraceptive behaviors.

Research has shown that teenagers who live in low-income households, reside in rural areas, have parents with low levels education, and are born to teenage mothers are at higher risk of experiencing pregnancy (Dehlendorf, Rodriguez, Levy, Borrero, & Sterinauer, 2010; Hall et al., 2017; WHO, 2014). There are also factors such as substance use, unprotected sexual intercourse, and experiencing child abuse and neglect that have been shown to be associated with teenage pregnancy (Garwood, Lara, Melissa, Katie, & Brett, 2015; Jaccord, 2009; Salas-Wright, Vaughn, Ugalde, & Todic, 2015). In our study, we were unable to use information on such factors as the majority of data was missing for adolescents' contraception, substance use, and sexual violence. Having information on adolescents' contraceptive and substance use as well as sexual violence could enrich the study by allowing us to better understand how adolescents with a depression onset at the age of sexual debut would behave at the time of sex compared to their non-depressed counterparts and how these factors at the time of having sex may influence their likelihood for becoming pregnant. Research and data collection on reproductive and sexual health of adolescents is challenging (Darroch, Singh, Woog, Bankole, & Ashford, 2016) and therefore, future

research should explore alternative ways to that used in NCS-A to gather information on sensitive subjects from adolescents. Utilizing technology used by teenagers such as online anonymous surveys through which they would feel more comfortable sharing their experiences could be a way to address this issue. Furthermore, the WHO has a list of guidelines that could help researchers improve data collection from adolescents (World Health Organization, 2018).

As mentioned earlier, the theoretical model proposed in this dissertation may help explain the possible mechanism by which depressive mood can influence women's decisions surrounding contraceptive behaviors, consequently placing them at risk of pregnancy. However, we did not measure the elements of these mechanisms such as women's low motivation, low self-efficacy, or negative affectivity in this study. Therefore, measuring factors such as low motivation and low self-efficacy through which depressive state is manifested in a person, can provide a systematic support for the proposed theoretical model and can enrich the findings of studies by providing a more in-depth picture of how depression can influence women's reproductive decision-making process.

Lack of prospective population based cohorts with rich information on the mental and reproductive health of women in the United States is a limitation of this area of research. For instance, NCS-A is a great source of rich information on adolescent mental health. However, it does not contain sufficient information on adolescent girls' contraceptive behaviors and pregnancy outcomes. Also, the cross-sectional design of this dataset may limit our ability to make claims about causality. Other available datasets such as National Survey of Family Growth (National Center

for Health Statistics, 2017) have rich information on women's contraception, reproductive health and fertility but not measurements of depression. Conducting longitudinal population-based studies with information on both mental and reproductive health can provide researchers with a great resource to investigate the effect of mental health on women's reproductive health in a more in-depth manner.

Implications for Public Health

As evident by the findings from this dissertation, addressing women's mental health in reproductive health settings is necessary in an effort to decrease the rate of unintended and teenage pregnancies in the United States, especially among populations at a high risk for unintended pregnancy including low-income women, those with previous experience of abortions, and adolescent girls. This objective can be accomplished in different ways. First, Quality Family Planning guidelines recommended by the CDC and the Office of Population Affairs can be modified to include provisions of depression screening in reproductive health settings for all women as part of determining clients' needs during routine reproductive health visits (Gavin, Pazol, & Ahrens, 2017). Second, the Title X Family Planning Program could fund provisions of mental health screening at Title X clinics. Funds could be used for training reproductive health practitioners at these clinics to screen, detect and treat women at risk for depression or to make referrals to mental health providers. These provisions at the federal and state levels can create change in reproductive and family planning practices serving populations of women including low-income and adolescents who are at a high risk for experiencing unintended pregnancies.

Implications for Practice

The importance of mental health in women's reproductive life has been globally recognized (World Health Organization, 2009), but gaps in the translation of this knowledge into practice still exist. As awareness surrounding the association between women's mental health and reproductive health continues to grow, there are opportunities to influence and improve the current practices around contraceptive counseling and family planning. This dissertation provides further evidence for the significance of the link between women's mental health, their contraceptive behaviors and their reproductive health trajectories. Interventions that systematically integrate mental health and reproductive health can reduce unintended pregnancies and optimize contraceptive use in the at risk population of women with mental health issues.

Mental Health Screening in Reproductive Health Setting

Reproductive health settings including family planning and abortion clinics are settings where women make decisions about contraception and their reproductive health together with their healthcare providers. Therefore, these settings are optimal for screening women for mental health issues and the healthcare providers can play a critical role in women's decisions surrounding contraception and future reproductive planning (Dehlendorf et al., 2010; Dehlendorf et al., 2013; Wyatt et al., 2014).

Although reproductive healthcare providers acknowledge the importance of mental health, lack of knowledge or training may impede them from evaluating mental health issues adequately (Leddy, Lawrence, & Schulkin, 2011; Ross et al.,

2015). Therefore, reproductive healthcare providers should be fully trained in recognizing signs and symptoms of depression in their clients and taking further actions in assisting clients in needs of mental health services (Hall et al., 2015). Ideally, depression-screening instruments such as CES-D should be routinely used to detect individuals' current risk for depression. Reproductive health physicians should provide these women with adequate in-house treatment at to address the condition where possible. However, it should be recognized that reproductive healthcare providers have a limited amount of time and the training to be able to complete such instruments during patient-doctor sessions and offer in-house treatment. Therefore, screener questions can be asked during the sessions that would help detect women at risk for mental health, minimizing the time constraints. Women at risk for depression should then be referred to specialists for further examination and also be connected to community resources to help them with management of their condition. Information on women's mental health history, and important risk factors associated with mental health should also be obtained as part of their health history at reproductive health settings and be considered by the physician during the counseling sessions.

Contraceptive counseling sessions should be tailored to the needs of individual women, and healthcare providers should realize the impact they have on women's reproductive decisions (Branden, 1998). The methods of communication between the healthcare provider and the individual women should go beyond simply delivery of the information. The healthcare providers should recognize depression signs and symptoms (e.g. low motivation and low self-efficacy, and focusing more on the negative effects of matters) and the influence these symptoms have on women's

contraceptive behaviors including choice of a less effective contraceptive method, discontinuation of the method (Garbers et al., 2011; Hall et al., 2012), and views about pregnancy (Frost & Darroch, 2008). The communication should include opportunities for women to ask questions. The healthcare provider should ensure that the information is not just conveyed but is understood by the patient. This could be accomplished by asking women open-ended question about their reproductive plans. The healthcare provider should try to address all the concerns depressed women may have regarding different contraceptive methods and their side effects, while remaining vigilant about negative affectivity in the patient's interpretation of these side effects, and provide them with accurate information on which contraception options are available, which ones are most effective in pregnancy prevention, side effects associated with each method, and specific regimen associated with the use of each method.

Reproductive counseling in mental health settings

Similar to reproductive health physicians, mental health specialists should recognize the implications of women's mental health on contraceptive behaviors and reproductive decision. They should be educated on different contraceptive methods and their characteristics and effectively convey the information to women whose first point of contact with the health care system is the mental health setting. If in-house counseling is not possible, mental health specialist should make referrals to the reproductive health providers.

These considerations and actions illustrate the importance of a direct and effective communication between women and their reproductive healthcare provider

to help minimize the effect of depression on women's contraceptive decision-making and to help them make informed decisions that best serve their needs and lifestyle and in turn increase women's compliance to the contraceptive method they have chosen.

Contraceptive counseling for adolescents

Contraceptive counseling practices can be applied to all women of reproductive age, including teenagers. However, there are characteristics unique to adolescents that should be recognized and addressed during contraceptive counseling. The role of healthcare providers especially pediatricians in addressing the mental and reproductive health needs of adolescents is very important (Ott, Sucato, & Committee on Adolescence, 2014). Therefore, an effective communication between the healthcare provider and the adolescent is critical. Contraceptive decision-making that suits an adolescent's needs could be reached through a heightened communication and trust between the doctor and the patient (Carvajal, Giola, Mudafort, Brown, & Barnet, 2017). Research has shown that pediatricians are seen as a trusted source of information for information on sexual health (Jones & Biddlecom, 2011; Ott, Rosenberger, McBride, & Woodcox, 2011). Therefore, pediatricians should be fully trained to identify the signs and symptoms of depression in adolescents and make referrals to specialists for those teens at risk for developing depression if treatment options are not available at the pediatrician's office. When it comes to adolescents' reproduction, physicians should recognize that teenagers may have a strong perception about the benefits of childbearing and that depression may lead women to feel ambivalent about pregnancy, both of which may influence their contraceptive behaviors (Francis et al., 2015; Rocca, Harper, & Raine-Bennett, 2013). Pediatricians

should routinely talk to teenagers about their reproductive health plans and contraception.

Research has shown that compared to young adults, adolescents have lower levels of awareness about availability of contraception and less knowledge on specific methods (Craig, Dehlendorf, Borrero, Harper, & Rocca, 2014). Also, despite being the most effective contraceptive methods for pregnancy prevention, the LARC usage is still low among adolescents (Romero et al., 2015). Therefore, healthcare providers should acknowledge that adolescents may not be fully aware of all available contraceptive methods, their effectiveness levels and most effective contraception for pregnancy prevention (LARC methods), side effects of different methods, and specific regimen required for each method. Additionally, use of dual methods for prevention of sexually transmitted infections should also be discussed with adolescent as they may have multiple sexual partners. Physicians should also identify the barriers that adolescent may face in accessing different contraceptive methods and facilitate the provision of the methods to adolescents. Therefore, providers should not only convey the information about contraceptive methods to teenagers but they also need to ensure that the adolescents understand the information and can easily access the methods.

In addition to physician offices, another setting for educating adolescents on sexual and reproductive health is the sex education program at schools. Teaching teenage girls about contraceptive behaviors and contraceptive options, most effective methods for pregnancy prevention, and other risk factors associated with unprotected sex and teenage pregnancy should be a priority of health education at school.

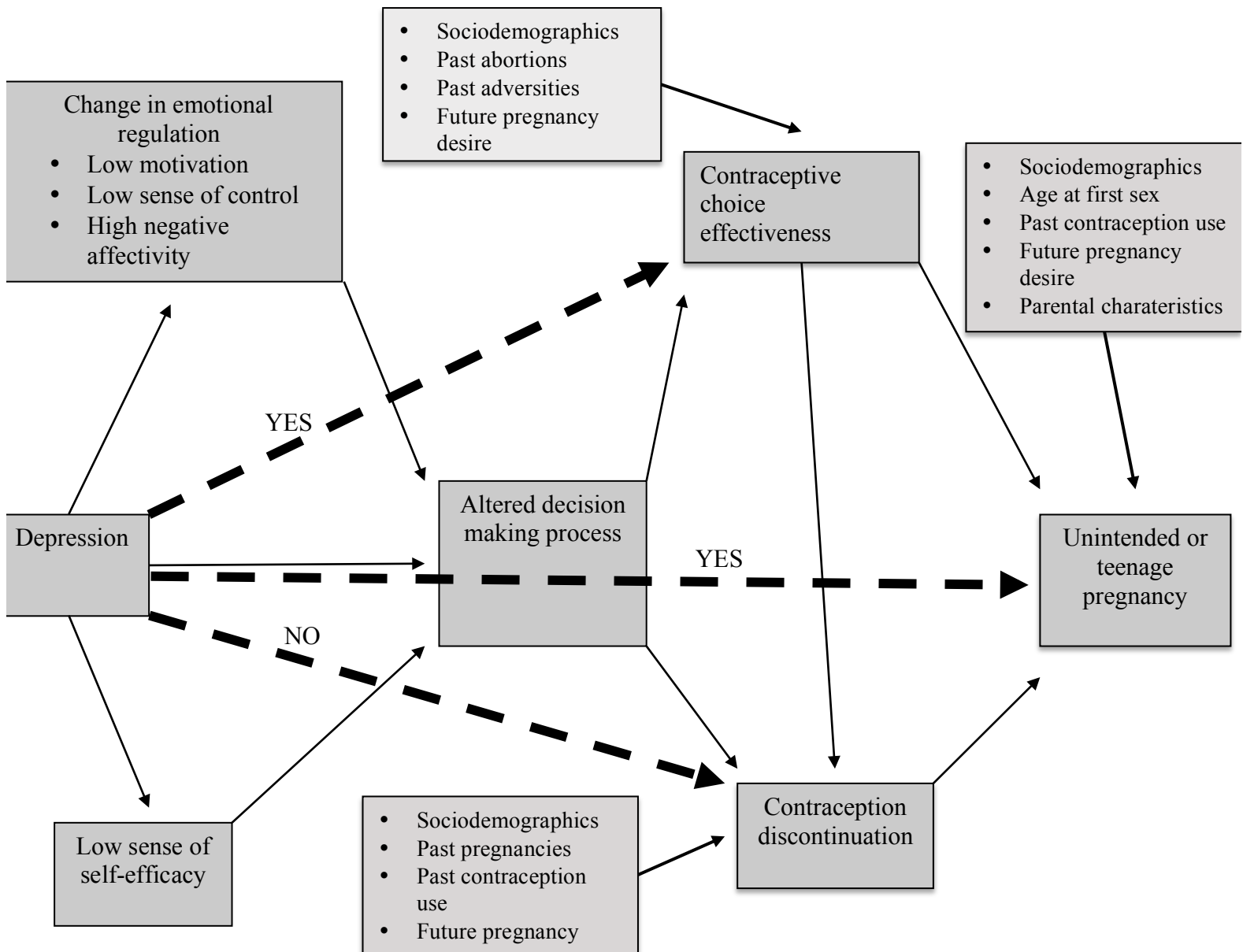
Furthermore, teaching adolescents to recognize signs and symptoms of depression in themselves and to communicate that with school personnel is also important and should also be a priority for schools.

Conclusion

Investigating the effects of depression on women's contraceptive behaviors and teenage pregnancy was the main focus of this dissertation. The results of this research demonstrated that the timing of depression plays an important role in women's contraceptive decision-making. Integration of mental health and reproductive health are warranted in the effort to optimize pregnancy outcomes in women at increased risk for depression. The implications of this research suggest that there is a need for more effective communication between reproductive health providers and patients, taking into consideration depressed women's subjective consideration of the topics of reproductive health, contraceptive choice and contraceptive compliance. Further research will be required to evaluate the nature of patient-physician interaction at reproductive and mental health settings in the effort to address the contraceptive and reproductive needs of women with mental health conditions adequately.

Appendix

Figure 1. Possible Mechanisms to Explain the Effects of Depression on Women’s Reproductive Behaviors and Unintended or Teen Pregnancy. The dashed lines indicate the three associations examined in this dissertations. “Yes” indicates the presence of a significant association. The “No” for the outcome of contraceptive discontinuation indicates the lack of a significant association when all methods were included in analyses, but it was in the expected direction (such that more depressive were associated with a higher hazard of discontinuation).



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