

**Examining the Factors that Moderate and Mediate
the Effects on the Relationship between Depression
and Anxiety and Major Pregnancy Complications
and Birth Outcomes**

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Abstract

Background

Depression is one of the common mental illnesses among women during their child bearing age. Though there is a high level of comorbidity, anxiety is often more prevalent than depression across pregnancy which complicate the pregnancy and birth outcomes. Given potential adverse consequences of depression or anxiety, little is known about the interaction effects as well as causal directionality of the risk factors for pregnancy complications and negative birth outcomes. Thus, the present study will explore the specific roles of the risk factors either as a moderator or as a mediator on the relationship between depression and anxiety and major pregnancy complications and poor birth outcomes. Moderator is defined as an independent variable which influences the strength or the direction of a relationship. On the other hand, mediator variable is defined as an explanatory link and conceptualized as a mechanism to better understand the relationship between a predictor and outcome variable in direct or indirect pathways. The objective of this paper is to understand how the relationship between depression or anxiety, and pregnancy complications and poor birth outcomes could be modified or mediated by other variables. The longitudinal and prospective nature of this study will allow us to examine the moderating and mediating effects more accurately at different time points. Therefore, the current thesis will add empirical evidence on moderating and mediating effects of the risk factors for pregnancy complications and birth outcomes. The findings of this study will be helpful for caregivers and health care professionals in shaping better interventions for women with mental health issues in pregnancy with the aim for bringing about total well-being of the mother.

Methods

Secondary data was used from the Feelings in Pregnancy and Motherhood (FIP) study. The study included a cohort of 646 high-risk women in Saskatoon. The participants were invited to take part in longitudinal follow up at 3 times: Time 1 = early pregnancy (17.4 \pm 4.9 weeks), Time 2 = later pregnancy (30.6 \pm 2.7 weeks) and time 3 = once after their babies were born (4.2 \pm 2.1 weeks). Self-reported data were collected through face to face interview. Edinburgh Postnatal Depression Scale (EPDS) was used to assess the depression and anxiety.

Depression and anxiety are considered as primary predictors while pregnancy complications and poor birth outcomes as outcome variables. For moderation and mediation analysis, sociodemographic factors such as age, education, income, ethnicity, abuse are examined as moderator variables. Behavioural and psychosocial factors are considered as mediator variables. A series of logistic regression analysis was used to analysis the moderation and mediation effects.

Results

In bivariate analysis, our results found that pregnancy complications and negative birth outcomes were significantly associated with depression, anxiety, education, income, marital status, ethnicity, abuses, social support, smoking, exercise, drinking alcohol, stress, quality of relationship with the current partner, in both the early and the late pregnancy. In mediation analysis, stress in late pregnancy was found to be partially mediating the pathway between depression and pregnancy complications. Moreover, stress showed a full mediation effect on the relationship between anxiety and pregnancy complications. In modelling moderating effects, women who reported depression or anxiety were more likely to have pregnancy complications if they also had experienced sexual abuse before or during early pregnancy, compared to those who did not. Women who reported anxiety in early pregnancy were more

likely to experience pregnancy complications if they were non-partnered compared to partnered women. In moderating analysis, in late pregnancy, sexual abuse, emotional abuse, ethnicity and age of the mother were identified as significant moderators. The findings suggest that sexually abused women who experienced depression or anxiety in their late pregnancy were more likely to report more than one pregnancy complications. Similarly, younger mothers were more likely to report anxiety in their late pregnancy resulting in more obstetric complications. Moreover, emotional abuse and ethnicity significantly moderated the relationships between depression or anxiety and poor birth outcomes (i.e. preterm delivery and low birth weight).

Conclusion

This study provides greater detail about how the risk factors during pregnancy may affect the relationships between maternal mental illness and adverse consequences. Results of this study could inform clinicians who treat and manage women during pregnancy and also promote targeted prevention and intervention programs. Finally, in light of this study, effective community intervention could help to improve physical and psychological wellbeing of both mother and baby, during and after pregnancy.

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Abbreviations

CIHR	: Canadian Institutes of Health Research
DSM-V	: Diagnostic and Statistical Manual for Mental Disorders, Fifth Edition
EPDS	: Edinburgh Postnatal Depression Scale
FIP	: Feelings in Pregnancy and Motherhood Study
PPH	: Postpartum Hemorrhage
PROM	: Premature Rupture of Membranes

CHAPTER 1: Introduction

Pregnancy is often considered to be the happiest time of a woman's life (Bowen, Bowen, Balbuena, & Muhajarine, 2012). It marks a time of role change and transition, not only physically, but also socially and psychologically (Golbasi, Kelleci, Kisacik, & Cetin, 2010; Li et al., 2012). However, many women experience depression, anxiety, and mental stress due to social and psychosocial influences, before and after pregnancy (Rahman, Bowen, & Muhajarine, 2014; Shah, Bowen, Afridi, Nowshad, & Muhajarine, 2011). The empirical literature report that depression has become a major public health concern especially for women during their childbearing age, and is one of the leading causes of disease burden (Hu, Li, Zhang, & Yan, 2015; Rubertsson, Wickberg, Gustavsson, & Rådestad, 2005; Shah et al., 2011). Several studies have been conducted to assess depression with varying sample sizes, characteristics, locations, measuring tools and trimester. Many of them reported that approximately 11% - 27% of women experience depression during and after their pregnancy (Golbasi et al., 2010; Rahman et al., 2014; Schwartz, Bowen, & Muhajarine, 2015).

There is significant evidence that shows that depression and anxiety during pregnancy are associated with potential risk factors such as marital status, socio-economic status, unwanted pregnancy, various stressors, lack of social support etc. (Nunes & Phipps, 2013; Rubertsson et al., 2005). These results in various types of pregnancy complications, poor birth outcomes, and hinders the proper development of the fetus (Alder, Fink, Bitzer, Hösli, & Holzgreve, 2007; Gausia et al., 2012; Smith, Huber, Issel, & Warren-Findlow, 2015). A recent study found that women who suffered from depression or anxiety during their pregnancy were more likely to report nausea, vomiting, headaches, dizziness, breathing problem, sleep disorders, and abdominal pain than the women who did not experience depression or anxiety

(Schwartz et al., 2015). Moreover, depressed women are reluctant to engage in antenatal and postnatal care (Rahman et al., 2014) which results in more pregnancy complications and poor birth outcomes, including preterm birth and low birth weight (Accortt, Cheadle, & Schetter, 2015; Schwartz et al., 2015).

1.1 Rationale and significance of the study

The rationale of this study illustrates that depression and anxiety is related to major pregnancy complications and birth outcomes. Depressive symptoms during the course of pregnancy are reported to be associated with obstetric complications and poor delivery outcomes (Robertson, Grace, Wallington, & Stewart, 2004). Individual observational and analytical epidemiological studies suggest that depression during and after pregnancy may result in deleterious neonatal and obstetric outcomes, such as low birth weight, preterm birth, decreased breastfeeding initiation and lengthened pre-delivery time (Andersson, Sundstrom-Poromaa, Wulff, Astrom, & Bixo, 2004; Hu et al., 2015). Hu et. al, 2015 reported two meta-analysis studies that examined the impact of depression during pregnancy (Hu et al., 2015). One meta-analysis showed that maternal depression increased the risk of preterm delivery and poor birth outcomes. Research also revealed that antenatal or postpartum depression may affect a child's cognitive, emotional, behavioural and social development in infancy, as well as, early childhood period (Becker, Weinberger, Chandy, & Schmukler, 2016; Gibson, McKenzie & McHarg, Shakespeare, Price, & Gray, 2009). Therefore, several studies have drawn particular attention to maternal depression which is associated with the health consequences for the mother but also to the development of the infant (Alder et al., 2007; Gausia et al., 2012). Many women are not familiar with maternal depression and its severity,

resulting in more difficulty recognizing the problem, and seeking help for proper antenatal care.

Prior studies have indicated that the underlying causes of antenatal anxiety and depression are different types abuse, domestic violence, low social support, low income, unplanned pregnancy, and history of depression (Inandi, Bugdayci, Dundar, Sumer, & Sasmaz, 2005; Toohey, 2012). However, anxiety also has been found to be associated with lack of positive attitude towards pregnancy, low education along with low income, dissatisfaction with the current relationship and low social support (Alder et al., 2007). Depression during pregnancy is treated as a key factor in heightening some risky behaviours such as smoking habit (Weobong et al., 2014), lack of physical activity (Gaston & Vamos, 2013), alcohol consumption, and recreational drug intake (Pajulo, Savonlahti, Sourander, Helenius, & Piha, 2001).

Furthermore, a survey by the National Center for Health Statistics in U.S. found that there is a strong correlation between depression and drug intake during and after pregnancy, this finding was consistent with other literature as well (Hanna, Faden, & Dufour, 1994). For instance, women who are depressed or anxious and had negative attitudes during their pregnancy are more likely to use alcohol, tobacco or other drugs, even after their children were born (Hanna et al., 1994; Littleton, Breitkopf, & Berenson, 2007). However, only a handful number of studies have implied that physical and emotional abuse are great indicators in developing depression among mothers resulting in negative outcomes, such as emotional and behavioural problems, poor cognitive development and poor well-being of children (LaCoursiere, Hirst, & Barrett-Connor, 2012; Robertson et al., 2004). Physical violence during pregnancy may worsen the condition of the mother and the fetus. Therefore,

women who suffer from physical and emotional abuse are more likely to experience adverse or poor pregnancy and birth outcomes (Muhajarine & D'Arcy, 1999).

A study in Ontario suggested that leisure-time physical activity may reduce maternal depression, prevent excessive weight gain and lessen pregnancy complications, such as gestational diabetes mellitus, pre-eclampsia and preterm birth (Gaston & Vamos, 2013). Despite the benefits, up to 60%, women remain inactive during their pregnancy. A retrospective finding also has identified that both intensity and duration of physical exercise decrease across pregnancy (Poudevigne & O'Connor, 2006).

Although a number of studies indicate an association between depression and pregnancy complications and poor birth outcomes, (Andersson et al., 2004; Schwartz et al., 2015), there is no significant evidence that indicates the magnitude of this risk as well as its's causal relationship. Therefore, this may have either moderating or mediating effects on the relationship between depression and anxiety and pregnancy complications and poor delivery outcomes. Rahman et al., 2014 reported significant moderating and mediating effects of potential risk factors in developing depression throughout the pregnancy period (Rahman et al., 2014). In epidemiological studies, it is often necessary to disentangle the causal pathway of the risk factors that link the exposure to the outcome (Richiardi, Bellocco, & Zugna, 2013). This paper will address how modifiable risk factors such as poor physical activity, different types of abuse, drinking alcohol, smoking or using recreational drugs may exacerbate or improve the linkage between depression and anxiety and pregnancy complications and birth outcomes.

Despite the increasing number of literature suggesting, a linkage between depression and anxiety and pregnancy complications and birth outcomes (Brittain et al., 2015; Kurki, Hiilesmaa, Raitasalo, Mattila, & Ylikorkala, 2000), there is a paucity of knowledge in

understanding the mechanism or causal pathways of these risks. This present longitudinal study used the secondary analysis of data from Feelings in Pregnancy and Motherhood (FIP) study to examine the potential moderator or mediator effect on this relationship at three-time points i.e. early pregnancy, late pregnancy and early postpartum. Therefore, it is understood that longitudinal study is better for understanding the underlying mechanism where exposure and mediator vary over time (Frazier, Tix, & Barron, 2004).

In this study, potential risk factors will be specifically identified as either a moderator or mediator of the relationship between depression and anxiety and pregnancy and birth outcomes. The findings from this research could help prioritize programs and help raise awareness and effective community interventions in mitigating or reducing these risk factors. Furthermore, identifying as mediators or moderators different types of psychosocial and behavioural factors can create modifiable pathways that cause depression or anxiety during the course of pregnancy. Therefore, this study will allow healthcare professionals to develop targeted interventions for specific groups of pregnant women.

1.2 Purpose of the study

The primary aim of this present study is to explore the relationship between depression and anxiety in pregnancy and pregnancy complications and poor birth outcomes. This thesis will also examine the moderating and mediating effect on this relationship through two time points in pregnancy and into postpartum at one point.

It is evident that physical activity during pregnancy promotes the mental and physical health of both the mother and her fetus, and decreases pregnancy complications and birth outcomes.

Therefore, the second objective is to understand the benefit of healthy behaviour i.e. physical activity on the maternal mental health and pregnancy and birth outcomes.

The final objective of this study is to seek how the primary association of interest maternal mental health and pregnancy and birth outcomes is modified and mediated by certain variables such as physical, emotional or sexual abuse or the use of drugs including alcohol. It is assumed that any form of abuse and drug use, acting simultaneously or individually may worsen this relationship resulting more pregnancy difficulties and poor delivery outcomes.

CHAPTER 2: Literature review

This chapter illustrates the association between depression and anxiety in pregnancy period which is related to pregnancy complications and poor birth outcomes. This chapter describes the impact of possible risk factors resulting depression and anxiety and its adverse consequences for both the mother and fetus. At the end, this chapter provides a brief idea about the specific role of these risk factors i.e. acting either as a moderator or mediator variable on the relationship between depression and anxiety and pregnancy complications and birth outcomes.

2.1 Definition of depression and anxiety

Depression has become a major public health concern since early 21st century which is more frequent among women during pregnancy (Davalos, Yadon, & Tregellas, 2012; Hu et al., 2015). According to WHO, depression is defined as “a common mental disorder, characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, feelings of tiredness, and poor concentration” (World Health Organization, 2016). Although many people may experience sadness or feel less energetic periodically, a person with the major depressive disorder usually experiences sad or hopeless for a longer duration. To qualify as a major depressive disorder, a woman must have at least five of the symptoms documented in the Diagnostic and Statistical Manual for Mental Disorder, Fifth Edition (DSM-V) (American Psychological Association, 1994). According to DSM-V, a person having to be diagnosed with major depressive disorder must experience at least five of the following symptoms in almost everyday over the two weeks period and one of these five has to be related either depressed mood or loss of pleasure or interest in work.

1. Depressed mood in almost everyday in a week i.e. feeling sad or hopeless all the time
2. Loss of interest or pleasure in work or any activity in daily life

3. Loss or gain of weight
4. Unable to sleep properly or sleeping excessively in almost everyday
5. Psychomotor agitation or retardation
6. Feeling less energetic or fatigue nearly everyday
7. Feeling guilty or hopeless all the time
8. Unable or decrease the ability to concentrate on anything
9. Repeated thoughts of death without any plan or suicidal idea

According to WHO, depression is marked as an important global burden of disease which is more frequent among women than men (World Health Organization, 2016). Moreover, women in their reproductive age seem to be more vulnerable to experience depression than other women (Smith et al., 2015).

Although anxiety disorder is also mentioned in DSM-V, Craske et. al., 2009 stated that anxiety symptoms included worry, avoidance, and muscle tension (Craske et al., 2009). American Psychological Association defined “Anxiety” as an “emotion characterized by feelings of tension, worried thoughts and physical changes like increased blood pressure” (American Psychological Association, 2016). Examining anxiety during the course of pregnancy is reported as a general concept rather than particular diagnosis. According to DSM-V, a person with anxiety disorder remains worried in a various domain including workplace, feel restlessness or fatigue, mood irritability, lack of concentration and sleep disturbance. On the other hand, pregnancy induced anxiety is defined as “worries, concerns, and fears about pregnancy, childbirth, the health of the infant, and future parenting, also associated with perinatal outcomes” (Littleton et al., 2007).

2.2 Prevalence of depression and anxiety during pregnancy

Childbirth represents a time of great vulnerability for women with antenatal and postpartum mood disorders (Dennis, Janssen, & Singer, 2004). The most common form of these disorders is depression and anxiety which results in maternal morbidity following pregnancy complications and delivery outcomes (Grote et al., 2010; Pearlstein, 2015). Another recent study suggests that depression may affect up to 29% women during pregnancy more than other stages of lives (Underwood, Waldie, D'Souza, Peterson, & Morton, 2016). The prevalence of depression is more frequent in the first trimester around 11% which drops to 8.5% in second and third trimester (Pearlstein, 2015). Approximately 10% to 20% women suffer from antenatal and postnatal depression during their pregnancy period while the prevalence of antenatal depression could be higher than postpartum depression (Rahman et al., 2014). Bowen et. al. also found that prevalence of depression among women in Saskatchewan is as high as 29.5% (Bowen, Stewart, Baetz, & Muhajarine, 2009). Several studies indicate that depression is highly comorbid with anxiety and also a risk factor for postpartum depression among mothers (Lancaster et al., 2010; Toohey, 2012). A cross-sectional study reported the prevalence of antenatal anxiety is 59.5% (Faisal-Cury & Menezes, 2007). However, the prevalence of antenatal anxiety varies widely from 9.1% to 59.5% (Grote et al., 2010). The prevalence of depression and anxiety may vary for several reasons such as differences in (1) study design, methodology, sample sizes, and the timing, frequency, and type of antenatal depression measurement; (2) misclassification bias with respect to depression or birth outcomes, (3) use of different screening tools and cut-off points, (4) geographical locations (Ding et al., 2014; Grote et al., 2010).

2.3 Consequences of depression and anxiety on pregnancy and delivery outcomes

Depression in pregnancy profoundly affects woman's daily activity, relationship and overall sense of well-being (Becker et al., 2016). Studies have also identified antenatal depression as one of the major risk factors in developing postnatal depression, adverse obstetric complications, birth outcomes, and growth retardation of the fetus (Adewuya, Ola, Aloba, Dada, & Fasoto, 2007; Grote et al., 2010). Although epidemiological studies suggested a link between depression and negative health outcomes, findings are not consistent (Grote et al., 2010; Szegda, Markenson, Bertone-Johnson, & Chasan-Taber, 2013). However, research indicates that untreated depression or anxiety during pregnancy may lead to negative birth outcome and growth of the fetus (Dunkel Schetter, Niles, Guardino, Khaled, & Kramer, 2016). A systematic review by Alder et al., 2007 mentioned that there is relatively less evidence which directly addresses the relationship between major depressive symptoms and pregnancy outcomes. It is likely that women who experience depressive symptoms during their pregnancy have higher pregnancy complications such as pre-eclampsia, nausea etc. compared with other women (Alder et al., 2007).

A meta-analysis suggests that women with depression or anxiety disorder are at higher risk of developing pregnancy complications such as gestational diabetes, gestational hypertension and pre-eclampsia (Grote et al., 2010). Therefore, depressed women are more likely to report either type 1 or 2 diabetes mellitus during their pregnancy. Moreover, approximately 9.2% women experience gestational diabetes during their pregnancy (Morrison, McCook, & Bailey, 2016). Another cross-sectional study also concludes the link between depression and gestational diabetes. The same study reported that about 17% women suffered from gestational diabetes due to depressive symptoms (Engberg et al., 2015). Conversely, a prospective study found no significant association between diabetes and depression during

pregnancy (Miller, Peri, & Gossett, 2016). In Canada, pre-eclampsia was one of the major causes of maternal morbidity between 1997 and 2000 (Yu et al., 2013). In general, pre-eclampsia is more common during pregnancies which occurs in 5% -8% among pregnant women (Simeone et al., 2015). Additionally, pre-eclampsia was also found to be related to depression (Kharaghani et al., 2012). A prospective population-based study found that women with depression disorder were 2.5 times higher risk of experiencing pre-eclampsia. In addition, women with anxiety disorder had 3.2 fold increased the risk for pre-eclampsia compared to those without (Kurki et al., 2000). Another case-control study indicates women with severe depression are 2.97 fold more likely to have pre-eclampsia than women who are moderately depressed (Kharaghani et al., 2012). Studies also suggest that depression or anxiety during pregnancy increased the risk of adverse neonatal outcomes such as preterm delivery, low birth weight, impaired infant growth, and operative delivery (Andersson et al., 2004; Dunkel Schetter et al., 2016). In U.S. depression in pregnancy has been identified as a potential risk factor for preterm birth, low birth weight and overall infant mortality and morbidity. Studies indicated that preterm delivery and low birth weight are strongly associated with depression (Ayele et al., 2016) which in turn lead to delayed motor development of the fetus. On the contrary, a cohort study in South Africa found no relationship between antenatal depression and preterm birth (Brittain et al., 2015). Other biomedical consequences such as decreased breastfeeding initiation, disturbance of eating and sleeping, lack of receiving health care services are also observed among mothers who experienced depression during or after pregnancy (Ayele et al., 2016).

In general, 60% women who experience major depression also meet the criteria for anxiety disorder (Lancaster et al., 2010). Maternal anxiety is also associated with impaired fetal growth and motor development of the child (Dunkel Schetter et al., 2016; Simeone et al., 2015). A systematic review and meta-analyses also reported a significant association between

maternal anxiety and poor birth outcomes particularly preterm birth and low birth weight (Ding et al., 2014). In addition, anxiety during pregnancy may lead to pregnancy and labour complications such as preterm labour, pre-eclampsia and decreased uterine blood flow (Littleton et al., 2007). A prospective case-control study in Sweden showed an association between maternal anxiety and pregnancy outcomes. The study found that about 60% and 40% women had preterm premature rupture of membrane and vaginal bleeding compared with the control group. Furthermore, pre-eclampsia, genital tract infection, premature contraction, and small gestational age are also common among women who have anxiety (Lillicreutz, Larén, Sydsjö, & Josefsson, 2016). A recent study in China reported an association between pregnancy-induced hypertension and anxiety. The same author also mentioned that mother in late pregnancy may suffer more anxiety due to physical discomfort which may lead to pregnancy complications and poor delivery outcomes such as preterm delivery, low birth weight etc. (Kang et al., 2016).

Although the prevalence of depression or anxiety and its severity may vary in different studies, it is now well evident that depression or anxiety adversely affects maternal and neonatal health. Women with depression or anxiety are at higher risk in involving themselves in poor health behaviours such as lack of receiving prenatal care, increased smoking and substance abuse, drinking alcohol, poor nutrition status, lack of physical activity, reluctant to take vitamins and other prescribed medication and increased suicidal tendency (Littleton et al., 2007; Pearlstein, 2015).

2.4 Moderating and mediating effects of risk factors

Research based on mediation and moderation models has emerged as a critical method which is useful for developing and testing-theory as well as for the identification of possible points of intervention in applied work (Rose, Holmbeck, Coakley, & Franks, 2004). Exploring both moderating and mediating effects on the same data allow a researcher to investigate more deeply the complex research hypotheses (Fairchild & MacKinnon, 2009). Longitudinal mediational analyses permit researchers to test specific causal theories about time-ordered relationships among variables, and the particular mechanism or pathway by which a relationship follows (Rose et al., 2004). Since the present study used the longitudinal data so it is more appropriate to examine the moderating and mediating effects of the risk factors for pregnancy complications or poor birth outcomes.

In epidemiological studies, mediation analysis is one approach to understand the causal mechanism of the risk factors for developing appropriate intervention for the targeted population (Richiardi et al., 2013). The mediator is a variable which explores the underlying mechanism of the causal effect. On the other hand, the moderator is defined as a third variable which alters the cause-effect relationship (Wu & Zumbo, 2008). Moderation and mediation analysis are mostly used in intervention and prevention studies (Fairchild & MacKinnon, 2009). According to Frazier et. al., 2004 moderator analysis is the heart of theory-testing in social science. If a researcher does not take into account the moderating effects participants may inadvertently participate inappropriate or even harmful interventions. Therefore, identification of moderating variable in the epidemiological study implies the maturity and sophistication of a field of investigation (Frazier, Tix, & Barron, 2004). A moderator variable is an individual characteristic or innate attribute such as trait, ethnicity, gender, or culture etc. which are relatively stable characteristics of a person whereas

mediator variables are cognitive, behavioural or psychological state of a person which is changeable and dynamic (Wu & Zumbo, 2008).

A number of risk factors have been identified in developing depression and anxiety among women during and after pregnancy. The consequence of maternal depression or anxiety increases the risk of pregnancy complications (Alder et al., 2007) and poor perinatal outcomes (Becker et al., 2016). Potential risk factors reported by the authors for maternal depression and anxiety include the age of mother, low socioeconomic status, low level of education, single or married status, intimate partner violence (i.e. physical, sexual or emotional abuse), poor partner relationship, lack of social support, multiple stressors, poor behavioural activities etc. (Brittain et al., 2015; Lancaster et al., 2010; Toohey, 2012). Research exploring the link between depression and anxiety which result in pregnancy complications and poor delivery outcomes has been limited. Studies on moderating and mediating effects of the risk factors on this association are even more scant. In this study, we have considered the sociodemographic factors as moderator variable while psychosocial and behavioural factors are examined to find out the mediation effects on the relationship between maternal mental health, and poor pregnancy and birth outcomes.

2.4.1 Socio-demographic factors

Socio-demographic factors such as young maternal age, ethnicity, low level of education, low income, single mother status heightening the risk of depression or anxiety among mothers during or after their pregnancy (Ayele et al., 2016; Chojenta, Lucke, Forder, & Loxton, 2016; Witt, Wisk, Cheng, Hampton, & Hagen, 2012). It is estimated that about 17% teenage mothers are at higher risk of developing depression during and after pregnancy (Toohey, 2012). Schetter et al., 2016 also found that women at a younger age had higher anxiety disorder during their pregnancy (Dunkel Schetter et al., 2016). Another study

suggesting that young mothers are more likely to develop depression during pregnancy than older mothers. It is likely that young mothers may have poor social support and partner relationship. Hence, they experience more stress and challenges in their daily lives resulting depression or anxiety during pregnancy (Bowen, Bowen, Butt, Rahman, & Muhajarine, 2012). A prospective cohort study reported that antenatal depression was more frequent among black non-Hispanic pregnant women than other women. In addition, they had low socio-economic status and poor partner support (Cheng et al., 2016). Another study reported that black women are more likely to have pregnancy complications than white women (Witt, Wisk, Cheng, Hampton, & Hagen, 2012). Moreover, there is ample evidence indicated that race or ethnicities are associated with poor birth outcomes including low birth weight and preterm birth though the findings are inconsistent (Alexander, Kogan, Himes, Mor, & Goldenberg, 1999; Berg, Wilcox, & d'Almada, 2001; Lu & Chen, 2004). Besides that the prevalence of depression or anxiety is high among young mothers who had a low-income level. It is reported that low-income mothers are 1.56 times more likely to develop depression than high income mothers (Tabet, Flick, Cook, Xian, & Chang, 2016). A cross-sectional study in China also found that women who had a lower level of education and low socioeconomic status had higher pregnancy anxiety (Kang et al., 2016). Moreover, a number of epidemiological studies suggest that women in low-income areas have an increased risk of developing preeclampsia and other pregnancy complications and poor neonatal outcomes such as low birth weight (Dolatian et al., 2016; Kharaghani et al., 2012; Nasreen, Kabir, Forsell, & Edhborg, 2010). Research also suggests that unmarried women are more likely to develop depression or anxiety during pregnancy due to poor relationship with the partner (Brittain et al., 2015). Other studies found that women with involved partners are more likely to receive prenatal health and less likely to engage themselves in risk behaviours such as smoking or drinking alcohol (Cheng et al., 2016). Most of the studies highlight the risk

factors for developing depression or pregnancy complications as a consequence. Although little is known the moderating and mediating effects of these risk factors, Rahman et. al., 2014 reported certain socio-demographic factors either as a moderator or a mediator for depression at early and late pregnancy (Rahman et al., 2014).

2.4.2 Abuse

Intimate partner violence during pregnancy has become as major public health concern which increases the risk of poor health outcomes for mothers, fetuses, and infants (Sharps, Laughon, & Giangrande, 2007). Intimate partner abuse means “any behaviour within a current or past intimate relationship that involves (actual, attempted, or threatened) harm that may impact or detract from the victim’s physical, psychological, sexual, economic, or spiritual well-being” (Desmarais, Pritchard, Lowder, & Janssen, 2014). A growing body of research has shown that depression and anxiety during pregnancy might exacerbate by some form abuse (physical, emotional or sexual) (Alhusen, Ray, Sharps, & Bullock, 2015; Lara et al., 2014). It is reported that about 4%-9% women experience some form of abuses during pregnancy (Alhusen et al., 2015). Stewart et. al. also mentioned the prevalence of intimate partner violence during pregnancy ranges from 4%-17% in different locations in the United States (Stewart & Cecutti, 1993). However, the prevalence of abuse during the year preceding pregnancy ranging from 4% to 26%, whereas the prevalence of abuse during pregnancy has been reported to range from 4% to 8% (S. L. Martin, Mackie, Kupper, Buescher, & Moracco, 2001). It is reported that women, who are pregnant and hoping to get pregnant soon, have experienced physical abuse perpetrated by their spouse. Moreover, 67% abuse was done by the former or current partner while 14% were done by the family member (Lara et al., 2014; S. L. Martin et al., 2001). A population-based study in Mexico mentioned that pregnant women who suffer violence by their partners have 6.2 times higher risk of

developing depression while another study in Mexico has been reported that emotional violence (between 8% and 78%) is more commonly seen than physical violence (between 4% and 8%) among pregnant women. Another meta-analysis based on 37 studies stated that women who were victims of intimate partners' violence are 2 to 3 times in greater risk in depressive symptoms resulting more pregnancy complications and poor delivery outcomes (Lara et al., 2014). It is found that women who are physically abused before or during pregnancy often continue to experience abuse after the delivery, putting the health of both mother and fetus in jeopardy (S. L. Martin et al., 2001). A large number of studies found that abuse during pregnancy aggravated the situation and increased the risk of pregnancy and neonatal complications including spontaneous abortion, preterm contraction, neonatal death, excessive fetal growth, premature births, low birth weight, and poor nutritional status, difficulties with breastfeeding (Holden, McKenzie, Pruitt, Aaron, & Hall, 2012; Kendall-Tackett, 2007; Malta, McDonald, Hegadoren, Weller, & Tough, 2012). A recent meta-analysis found a positive association between abuse and adverse birth outcomes including low birth weight and preterm birth (Hill, Pallitto, McCleary-Sills, & Garcia-Moreno, 2016). Another study indicated that women who reported the physical assault or sexual coercion by their intimate partners before or during pregnancy have higher levels of depressive symptoms. Therefore they have an increased risk of developing pregnancy complications such as severe nausea, high blood pressure, vaginal bleeding, edema and urinary tract infection (Sarkar, 2008). Most of the epidemiological studies actively focus on elucidating the underlying causes of abuses during pregnancy and its consequences. Abuse during pregnancy has been found to be associated with a number of risk factors including unemployment, low education, younger age, single status along with depression (Coker, Sanderson, & Dong, 2004; Sarkar, 2008; Stewart & Cecutti, 1993). A study also suggests that depression may act as a mediator in engaging different types of risky behaviours such as

the use of tobacco, alcohol, and illicit drugs for the women who experienced abuse during pregnancy (Alhusen et al., 2015). In spite of its severity and consequences, there is not much known about the moderating or mediating role of abuse for maternal mental health or pregnancy and neonatal outcomes. Further research is needed to understand the causal pathway of any form of abuse linking pregnancy complications to maternal mental health.

2.4.3 Psychosocial factors

Psychosocial factors such as social support, psychological or general stress and satisfaction with the current relationship have potential influence in developing depression or anxiety among mothers which eventually causes poor pregnancy and birth outcomes. The present study will explore the causal and temporal precedence between these psychosocial factors and pregnancy complications related to maternal depression. Significant interaction between depression, anxiety and stress on poor birth outcomes are found as a complex pathway in both direct and indirect way (Staneva, Bogossian, Pritchard, & Wittkowski, 2015).

Cheng et al., 2016 found that pregnant women who report being in good relationships with the baby's father have less depressive symptoms, stress, and smoking than women who reported a poor relationship with the fathers. The authors also suggest that women who have a poor relationship with the partner have a higher risk of developing depression or anxiety due to low support from their partners which negatively influence themselves to engage in risky behaviours such as tobacco or drug use (Cheng et al., 2016). A cross-sectional study found that women are more likely to receive prenatal care if their partners are involved with them during pregnancy and give attention to the unborn child (L. T. Martin, McNamara, Milot, Halle, & Hair, 2007). Overall, social support from the partner is considered as a powerful protector against maternal mental illness. Dolatian et al. reported that approximately 25% women experience psychosocial stress during pregnancy period. Many

studies mentioned “stress” as an independent risk factor for developing depression or anxiety among women during pregnancy (Dunkel Schetter et al., 2016; Lancaster et al., 2010; Pajulo et al., 2001).

Moreover, psychological stress among pregnant women regarded as a risk factor for adverse birth outcomes and common pregnancy complications such as gestational hypertension, preeclampsia (Dolatian et al., 2016). A prospective case-control study found that about 54% women had a preterm delivery due to different types of stressors. Therefore, maternal stress increases the risk of pregnancy complications and negative birth outcomes such as preterm birth and low birth weight (Lilliecreutz et al., 2016). A possible biological explanation is that depression during pregnancy promotes the release of stress hormones which leads to pregnancy complications and negative birth outcomes by decreasing uterine blood flow (Becker et al., 2016). Social support, an idea related to partner support or involvement, is a significant correlate of maternal well-being during pregnancy and birth outcomes (Cheng et al., 2016). A Canadian cohort study suggested that anxiety during pregnancy was related to poor psycho-social support as well as higher stress during or after pregnancy (Dunkel Schetter et al., 2016). Women who had poor social support and endure everyday stressors were more likely to develop depression than other women. Therefore, depressed women were less likely to share or discuss their confidential or family matters with their husbands (Chojenta et al., 2016). Although the exact mechanism by which social support affects depression and anxiety remains obscure, it is found that women who experience poor social support have an increased risk of developing depression or anxiety during pregnancy which could lead to adverse health outcome for the mother (Waqas et al., 2015).

2.4.4 Behavioural factors

Smoking during pregnancy is considered as a modifiable risk factor which is more common among young than others. Smoking is also associated with maternal mental illness such as depression or anxiety. Smoking during pregnancy increases the risk of adverse neonatal outcomes such as miscarriage, reduced fetal growth, low birth-weight, premature birth, preeclampsia, placental complication, impaired infant's lung function, respiratory illness, cancer, impaired growth, and development of behavioural problems (Širvinskienė et al., 2016). It is reported that about 15% of all preterm births and 20%–30% of all infants' low birth weight are responsible for smoking during pregnancy (Andres & Day, 2000).

Additionally, exposure to smoking is one of the strongest predictors of alcohol consumption and other risky behaviours. Smoking increases the likelihood of drinking alcohol among mothers which poses more deleterious effects (Širvinskienė et al., 2016). Andres et al., 2000 also suggests that smoking during pregnancy is associated with pregnancy and delivery complications such as placenta previa, abruption placentae, premature rupture of the membranes. Despite the well-established risks associated with smoking about 15%-20% women smoke during pregnancy (Andres & Day, 2000). Several studies have shown that depression during pregnancy is linked to poor antenatal care and engaging in poor health behaviours including drinking alcohol, using others drugs, smoking (Kuczkowski, 2007; Širvinskienė et al., 2016).

One of the national surveys of Health Canada reported that 78% of women aged in between 15 to 44 consume alcohol as a part of their daily living while 3.1% women consume alcohol during their pregnancy period. Therefore, Gladstone et al., 1997 also stated that 6.2% of women in Ottawa and 12% of women in North Carolina engaged themselves in alcohol consumption (5 times or more per occasions) (Gladstone, Levy, Nulman, & Koren, 1997).

Širvinskienė et al., 2016 reported that smoking and alcohol showed synergistic harmful effects among women during pregnancy (Širvinskienė et al., 2016). Furthermore, there is no safe level of alcohol consumption during the course of pregnancy. Most frequently used substance during pregnancy include cocaine, amphetamines, opioids, marijuana, ethanol, tobacco, and caffeine (Kuczkowski, 2007). A study found that about 25000 women used the intravenous drug while nearly 90% of these women were of childbearing age (Gladstone et al., 1997; Mercer & Khavari, 1990). Regardless of the gestational period, use of any recreational drug or alcohol intake results in serious adverse fetal effect (Kuczkowski, 2007). Another survey from National Institute on Alcohol Abuse and Alcoholism in the US showed a positive association between depression and substance abuse (Hanna, Faden, & Dufour, 1994).

The research found that women who are single and low income, have poor social support during their pregnancy involve themselves in different types of risky behaviours such as smoking, using drugs or alcohol (Cheng et al., 2016). In addition, unwanted pregnancy and poor partner relationship exacerbate the situation among mothers who are depressed (Golbasi et al., 2010). Depression during pregnancy diminishes the ability for self-care such as taking adequate nutrition, receiving antenatal care and using drugs or alcohol which comprises a women's mental and physical health (Ayele et al., 2016). Rahman et al., 2014 also showed significant moderating and mediating relationship of these risky behaviours in developing depression among mothers (Rahman et al., 2014). Although the mechanism of risky behaviours contributing to adverse pregnancy and birth outcomes is still unclear, establish data supports the link between poor health behaviours and adverse birth outcomes (Pajulo et al., 2001).

Previous studies also found that lower level of physical activity during pregnancy may have a protective effect on the overall well-being of mother and her newborn baby (Demissie et al., 2013; Tendais, Figueiredo, Mota, & Conde, 2011). A population-based study in Sweden also suggested that women who reported leisure-time physical activity during their pregnancy were more like to report self-rated good health in compare with other women (Lindqvist et al., 2016). Another review article also suggests that intensity and duration of physical exercise have been declined during pregnancy in compared with pre-pregnancy and in the early and late pregnancy (Poudevigne & O'Connor, 2006).

A study in Canada reported that prevalence of regular physical activity was around 58% among pregnant women in Ontario. The same research also indicated that less than one in four women met current Canadian guidelines for exercise during pregnancy (Gaston & Vamos, 2013). Moreover, some studies also have found that depression and anxiety during pregnancy might be attenuated by regular physical exercise (Demissie et al., 2013; Poudevigne & O'Connor, 2006). To date, several studies reported that physical activity in pregnancy reduces pregnancy complications whereas a sedentary lifestyle was observed to be associated with the low birth weight of the fetus (Both, Overvest, Wildhagen, Golding, & Wildschut, 2010; Currie, Woolcott, Fell, Armson, & Dodds, 2014; Leppänen et al., 2014). Engaging in physical exercise during pregnancy play a beneficial role in lessening common pregnancy complications such as pre-eclampsia, gestational diabetes mellitus, gestational hypertension, postpartum weight gain etc. (Gaston & Vamos, 2013; Leppänen et al., 2014; Tendais et al., 2011) Furthermore, recommended physical activity during pregnancy was also considered as a protective key factor in reducing negative delivery outcomes such as preterm delivery, low birth weight, operative delivery etc. (Gaston & Vamos, 2013). Although there is limited data on moderating and mediating role of physical activity during pregnancy,

Rahman et al., 2014 reported the significant moderating effect of physical exercise for developing depression among Aboriginal mothers (Rahman et al., 2014).

By taking the advantage of using longitudinal data, the present thesis will analyse the moderating and mediating effects of certain risk factors on the relationship between depression and anxiety and major pregnancy complications and birth outcomes. It is important to understand the possible etiology of these risk factors and underlying mechanism on this link to develop appropriate interventions for the targeted women.

CHAPTER 3: Conceptual framework, research questions, and hypothesis

There is substantial empirical evidence that suggesting that depression and anxiety result in pregnancy complications and poor birth outcomes such as low birth weight, preterm delivery etc. Although prior studies have examined the association (Pajulo et al., 2001; Perkin, Bland, Peacock, & Anderson, 1993), only a few populations based study investigated the specific role of the risk factors i.e. moderating and mediating effect on this relationship.

Understanding moderating and mediating effects are important in developing proper interventions for the targeted population (Tang, Yu, Crits-Christoph, & Tu, 2009). This thesis will focus on examining the primary relationship between depression and anxiety and major pregnancy complications and birth outcomes. Accordingly, assess the specific role of risk factors as a potential moderator and mediator throughout the pregnancy, resulting in complications and poor delivery outcomes.

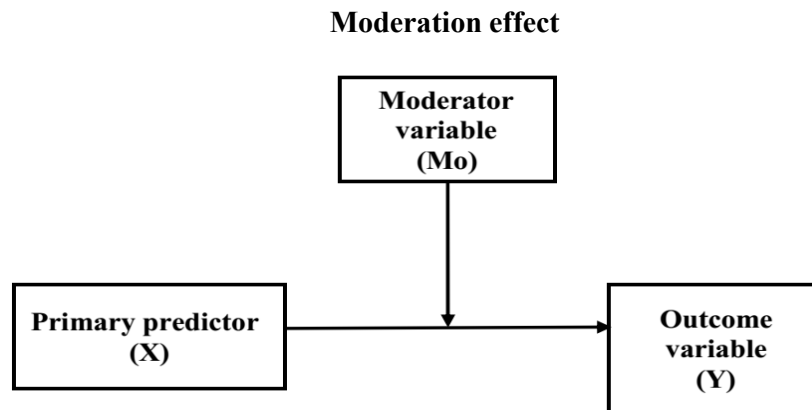
Even though moderation and mediation analysis are more frequently used in psychosocial and biomedical fields (Tang et al., 2009), it has become increasingly popular in social psychology and medical sciences as well (Wu & Zumbo, 2008). It is also important in epidemiological research to determine the impact and magnitude of the risk factors which helps to identify a mechanism in developing specific interventions for the targeted groups (Shrout & Bolger, 2002).

3.1 Moderating analysis

In general, a moderator is an independent variable which alters the strength or direction of a causal relationship (Wu & Zumbo, 2008). A moderator variable is defined as a third variable which specifies on whom or under what conditions the variable exerts its effect and the condition under which the direction and/or strength of an effect may differ (Frazier et al., 2004). Thus, a moderator variable often addresses question involving “when” or “for whom” which most strongly predicts or causes an outcome variable (Wu & Zumbo, 2008). However, strength and direction of a relationship between a predictor and outcome can be modified by potential moderator variables i.e. enhancing, reducing, or changing the influence of the predictor (Fairchild & MacKinnon, 2009). A moderating effect in statistical terminology is an “interaction”, where the effect of one variable depends on levels of the other variable in analysis (Frazier et al., 2004). Amery et al. mentioned a moderation effect is a special type of interaction effect i.e. “a causal interaction effect”, which involves a causal hypothesis and design underlying the observed data (Wu & Zumbo, 2008).

In order to examine a moderating effect on an outcome, three hierarchical multiple regression analysis are performed (Fairchild & MacKinnon, 2009). Figure 3.1 illustrates a conceptual path diagram of a moderation model. In the model, Predictor variables (X) is represented to exert a causal influence on the outcome variable (Y) with a unidirectional arrow pointing from X to Y. Moreover, this effect is further moderated or influenced by certain factors (Mo).

Figure 1: Conceptual diagram for moderation model



Identifying potential moderator variable is particularly important in an epidemiological study to address an appropriate intervention for the intended group (Rose et al., 2004). It is not only important for interventions studies (Frazier et al., 2004); for instance, a study found that depression during pregnancy was positively associated with pregnancy complications and poor birth outcomes. Although this result could be of interest to the researcher, this effect may become more or less robust in the presence of other contextual variables i.e. income level. By testing “income level” as a moderator variable, a researcher may explore more to understand this causal relationship. Thus, by developing specific theories about conditions which determine the strength the relationship between depression and pregnancy complications and delivery outcomes.

Therefore, this study will investigate sociodemographic characteristics, which are not modifiable (i.e. age, ethnicity) but might have a potential influence on the relationship between depression and anxiety and pregnancy complications and delivery outcomes. At the same time, this paper will also report possible risk factors which in turn will help us to identify women who are vulnerable.

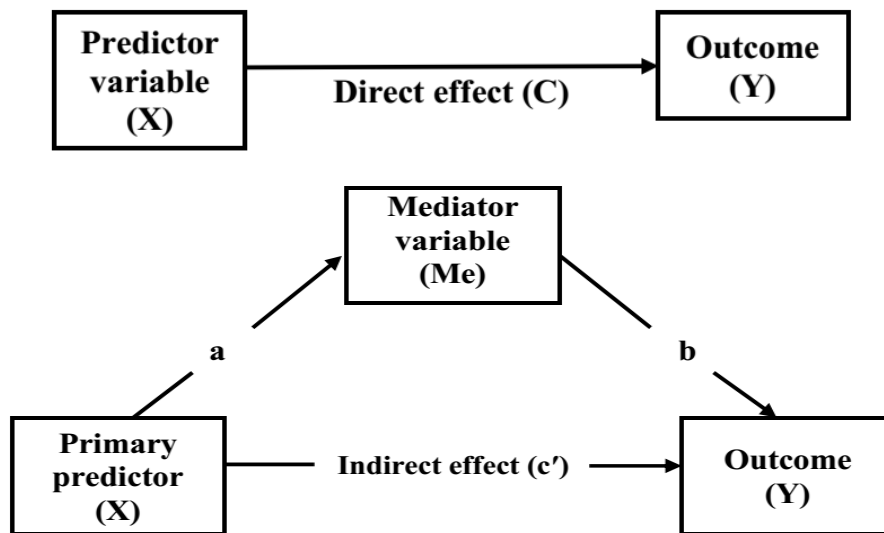
3.2 Mediating analysis

In some instances, the association between two variables is more complex than a simple relation between a predictor and outcome variable (Fairchild & MacKinnon, 2009). By definition, the mediator is an intermediate variable which explains the relationship between the predictor and outcome variable. Thus, a mediator variable is an explanatory link between two other variables which is conceptualized as the intermediate mechanism through which one variable (i.e., the predictor) effect another variable i.e., the criterion. For mediational hypothesis, two data points are needed to test causal time-ordered relationship (Rose et al., 2004). (Rose et al., 2004). Hence, longitudinal and prospective data are preferred for mediation analysis. Unlike a moderator, a mediator is considered as a third variable which causes variation of the outcome variable and itself is caused to vary by the predictor (Wu & Zumbo, 2008). Mediation analysis in epidemiological studies helps to disentangle the causal pathways that could explain the effect of an exposure on an outcome (Richiardi et al., 2013).

To identify a potential mediator variable, Baron and Kenny (1986) proposed a four-step approach in which several regression analyses are conducted and significance of the coefficients is examined at each step (Baron & Kenny, 1986). The purpose of Steps 1-3 is to establish that zero-order relationships among the variables exist. Assuming there are significant relationships from Steps 1 through 3, one proceeds to Step 4. In the Step 4 model, some form of mediation is supported if the effect of mediation (Me, path b) remains significant after controlling for X. If X is no longer significant when Me is controlled, the finding supports full mediation. If X is still significant (i.e., both X and Me both significantly predict Y), the finding supports partial mediation (Wu & Zumbo, 2008).

Figure 2 illustrates the conceptual diagram for a mediation effect. Here, X, a predictor variable is considered causing the outcome, Y which is a direct pathway, c. On the other hand, mediator “Me” is an intermediate variable which causally interferes this relationship and represents an indirect pathway, c’ to cause the outcome.

Figure 2: Conceptual path diagram for mediation model



In epidemiological research, it is often important to understand the causal model of a particular relationship aiming to design and measure the impact of public health interventions. For example, the study in Ontario found that physical exercise is a key protective factor in decreasing pregnancy complications during pregnancy which eventually results in healthy birth outcomes. Interestingly, this relation does not reveal the mechanism that underlies the relationship between physical exercise and pregnancy complications or birth outcomes. By examining mediating effect, a researcher might consider a third variable, e.g. physical exercise that may explain this causal pathway for better understanding this relationship. The present study will focus on different types of behavioural and psychosocial factors that operate as a mediator variable to cause the outcomes.

3.3 Research questions and hypotheses

1. What are the relationships between depression and anxiety (as measured by EPDS) and major pregnancy complications and poor birth outcomes?

Hypothesis 1. Depression and anxiety during pregnancy increase the risk of pregnancy and labour complications as well as poor birth outcomes (i.e. low birth weight). This study will examine the relation between depression and anxiety in early pregnancy period (Time 1) and major pregnancy complications and poor delivery outcomes in early postpartum (Time 3).

2. Does experiencing any form of abuse (physical, emotional or sexual) and sociodemographic factors modify or mediate the relationship between depression and anxiety and pregnancy complications and poor birth outcomes?

Hypothesis 2. Experiencing any form of abuse such as physical, emotional or sexual either before or during pregnancy, may exacerbate the effects of depression or anxiety on complications and poor delivery outcomes. Similarly, age of mother, level of education, income status, ethnicity, marital status may play an important role in developing depression which eventually results in pregnancy difficulties or poor birth outcomes. This study will examine the potential influences of these risk factors on the relationship between depression and anxiety measured in early pregnancy period (Time 1) and major complications and poor birth outcomes in early postpartum (Time 3). Figures 3 and 4 show the conceptual model of the moderation effect.

Figure 3: Moderating effects of socio-demographic factors on the relationship between depression and anxiety and pregnancy complications and poor birth outcomes (Using variables from Feelings in Pregnancy (FIP) project sample)

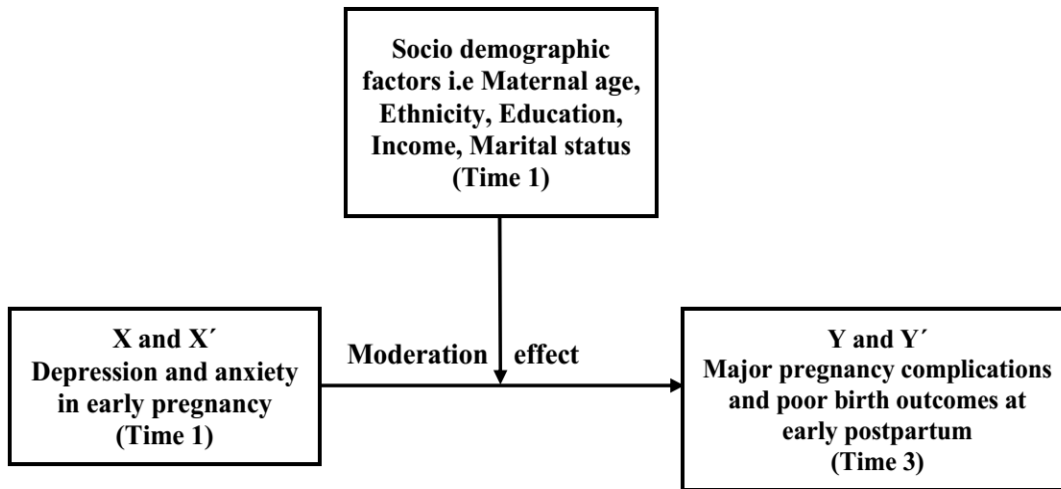
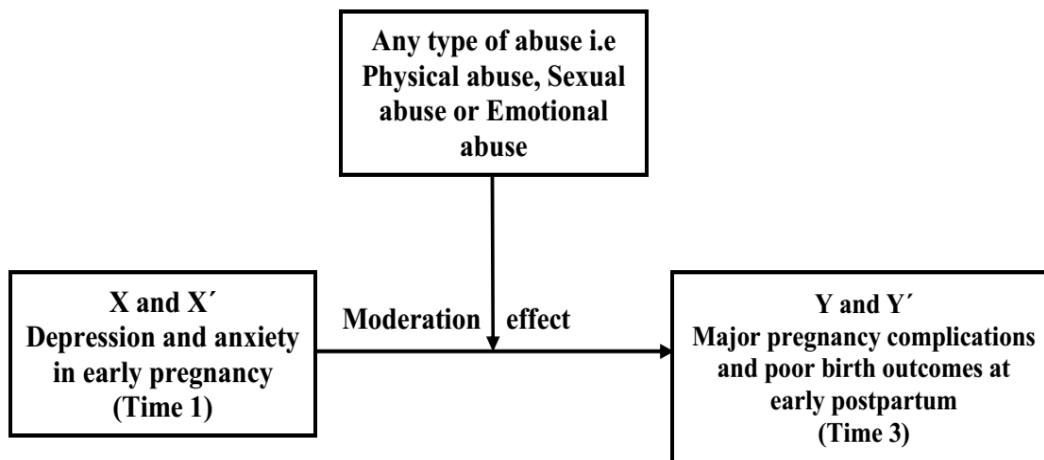


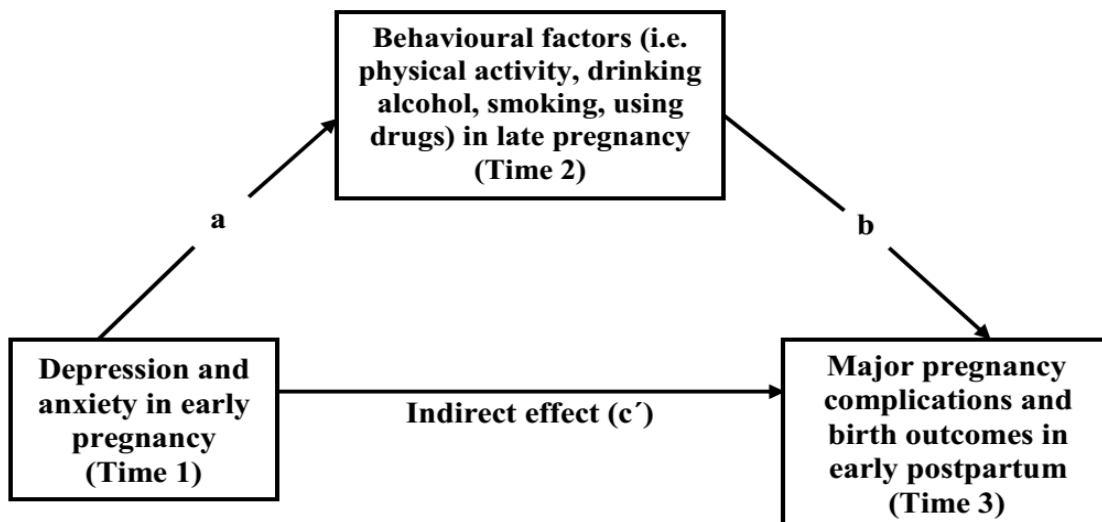
Figure 4: Moderating effects of different types of abuses on the relationship between depression and anxiety and pregnancy complications and poor birth outcomes (Using variables from Feelings in Pregnancy (FIP) project sample)



3. Do physical activity and other behavioural factors modify and/or mediate the relationship between depression and anxiety and pregnancy complications and poor birth outcomes?

Hypothesis 3. Leisure time physical activity (either 20-minute walking, swimming etc.) during the course of pregnancy play a beneficial role in reducing pregnancy-related complications and poor birth outcomes. On the other hand, drinking alcohol, smoking habit or using other drugs during the course of pregnancy results in harmful effects to both mother and fetus. This present study will seek to examine, how physical exercise and other behavioural factors in later pregnancy (Time 2) effect (mediate) the relationship between depression and anxiety measured in early pregnancy (Time 1), as well as major pregnancy complications and poor birth outcomes in early postpartum (Time 3). Figure 5 draws the conceptual model of the mediation effect.

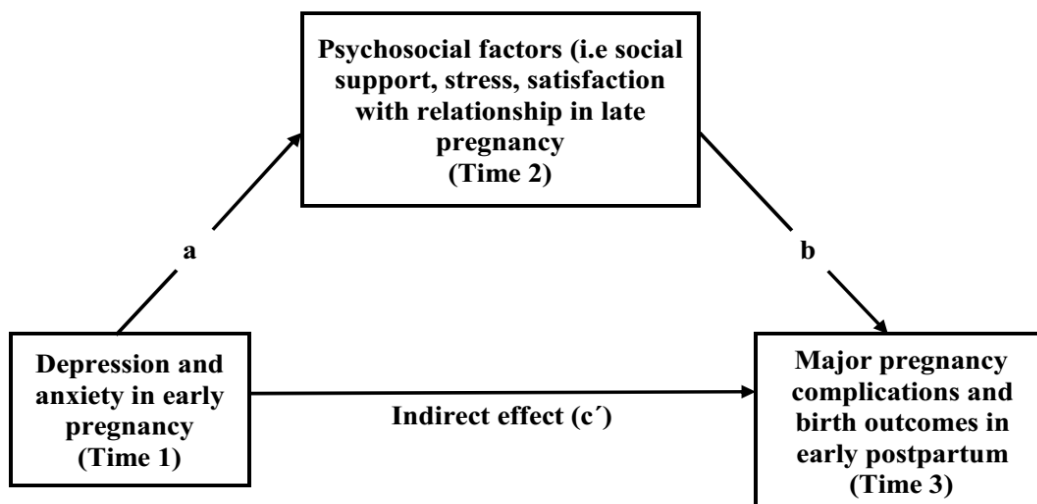
Figure 5: Mediating effects of different types of behavioural factors on the relationship between depression and anxiety and pregnancy complications and poor birth outcomes (Using variables from Feelings in Pregnancy (FIP) project sample)



4. Do psycho-social factors such as social support, stressors or quality of relationships with partner modify and/or mediate the relationship between depression and anxiety and pregnancy complications and poor birth outcomes?

Hypothesis 4. Lack of social support, different types of stressors or satisfaction with the current relationship during the pregnancy period result in deleterious effects to both mother and fetus which, in turn enhances pregnancy complications and poor birth outcomes. This present study will seek to examine, social support or stressors in later pregnancy (Time 2) effects the relationship between depression and anxiety measured in early pregnancy (Time 1) and major pregnancy complications and delivery outcomes in early postpartum (Time 3). Figure 6 illustrates the conceptual model of the mediating effect.

Figure 6: Mediating effects of different types of psycho-social factors on the relationship between depression and anxiety and pregnancy complications and poor birth outcomes (Using variables from Feelings in Pregnancy (FIP) project sample)



CHAPTER 4: Methodology

This chapter illustrates the study sample and source of data, study design and describes the predictor and outcome variables and a detail description of data analysis plan.

4.1 Study sample and data source

This study was based on the data collected from the Feelings in Pregnancy and Motherhood study (FIP) which was funded by Canadian Institute of Health and Research (CIHR) and the grant number for this project was IGP-77895. The study recruited pregnant women in between 2006-2008 years who lived in Saskatoon and nearby areas. Recruited participants were amongst the prenatal patients who were seen by physicians, maternity stores, or who volunteered to participate upon hearing about the study via posters, radio advertising. It was a longitudinal epidemiological study that included 646 women at inception. The participants were asked for consent to be followed up during their pregnancy and into their postpartum. The data has been collected through face to face interviews according to the questionnaire by the trained research assistant. This study was based on a secondary data analysis from this longitudinal study. Once participants were selected, they were invited to take part in longitudinal follow-up at 3 times: Time 1= early pregnancy (17.4 ± 4.9 weeks), Time 2 = later pregnancy (30.6 ± 2.7 weeks), and time 3 = once after their babies were born (4.2 ± 2.1 weeks).

4.2 Measures

4.2.1 Predictor variables

4.2.1.1 Primary predictors

To measure the primary predictor variables, Edinburg Postnatal Depression Scale (EPDS) was used as a screening tool to assess depression and anxiety at three-time points. EPDS scale has been translated into many languages from English and measures depression among women during and after their pregnancy (Hu, Li, Zhang, & Yan, 2015; Shah et al., 2011). The Edinburgh Postnatal Depression Scale (EPDS) is a self-report questionnaire originally designed by Cox and colleagues to screen for postnatal depression (Cox & Holden, 2003; Teissedre & Chabrol, 2004). The EPDS is a 10-item self-report questionnaire where women are asked to indicate how they felt in past 7 days (Gibson et al., 2009; Otake et al., 2014). Items 1 and 2 assess anhedonia; item 3, self-blame; item 4, anxiety; item 5, fear or panic; item 6, inability to cope; item 7, difficulty sleeping; item 8, sadness; item 9, tearfulness; and item 10, self-harm ideas. Responses are scored 0, 1, 2, and 3, increasing according to the severity of the symptom (Teissedre & Chabrol, 2004). The total score is calculated by adding the scores for each of the 10 items. The score can range from 0 to 30 (Golbasi et al., 2010). The validity of the EPDS has been widely documented. The internal consistency of the EPDS has previously been found to be satisfactory (Rahman et al., 2014). The scale has a sensitivity ranging from 34 % to 100% and a specificity ranging from 49% to 100% (Gibson et al., 2009).

For this study, the cut-off point for major depression was defined as score 12 or more. A systematic review by Gibson et. al. suggested EPDS score 12/13 as possible markers for “Major depression” (Gibson et al., 2009). The cutoff score for anxiety was used as score 4 or more for this research. A recent study has also used this anxiety subscale which

comprised of items 3, 4 and 5 and it validated the cut-off score of 4 or more (Engberg et al., 2015; Schwartz et al., 2015).

For the purpose of this thesis, EPDS variable was transformed into a categorical variable based on the cut-off value ≥ 12 . The categories for EPDS were as follows: 0 = No depression (a score of <12) and 1= major depression (a score of ≥ 12). Similarly, to measure the anxiety, EPDS was further categorized using a cut-off score ≥ 4 . The categories were as follows: 0 = No anxiety (a score of <4) and 1= anxiety (a score of ≥ 4).

Participants were also asked to disclose their previous history of depression and whether or not any of their family members had depression episodes. Many studies highlighted the history of depression as potential risk factors along with other factors but in this study, this will not be a focus. The History of depression is a significant predictor which may have a correlation with depression in current pregnancy. Thus, the history of depression could appear as a repetitive depression episode among individuals instead of developing incident depression (new cases) during their pregnancy. Hence, history of depression cannot be causally related to factors preceding the outcomes as this variable was excluded from the moderator and mediator analysis of my thesis.

4.2.1.2 Socio-demographic variables

Socio-demographic information of each participant was collected at the initial interview (at time point 1). Each participant was asked about their age, marital status, their ethnicity, education and household income as per questionnaire. A variable could be considered as a moderator variable which may have a potential impact either positive or negative to precede the outcomes and those are modifiable. By identifying probable/possible moderator effect, specific interventions can be approached for particular target groups of pregnant women.

Age of mother

At the beginning of the data analysis, age was a continuous variable but based on the frequency of descriptive statistics, age was coded as a dichotomous variable. For further analysis, age was categories as follows $0 \leq 25$ years old, and $1 \geq 25$ years or over.

Marital status

Marital status was transformed into two categories where 0 = single/widowed/divorced, and 1 = married/ common-law.

Ethnicity

Based on the descriptive statistics, ethnicity was transformed into three categories and the categories were 0 = Aboriginal, and 1 = Non-aboriginal

Education level

The level of education was collected as a categorical variable. It was further categorized into a dichotomous variable as follows: 0 = women who did not complete grade 12, and 1 = women who completed grade 12.

Income level

Household income was assessed though as receiving social assistance, less than \$20,000 per year, \$20,000 - \$39,000 per year and more than \$60,000 per year. Income variable was computed into a dichotomous variable where $0 \leq \$40,000$ per year, and $1 \geq \$40,000$ per year for this analysis.

Abuse

Participants were asked if they experienced any type of abuse such as physical, emotional or sexual during their pregnancy at the initial interview. Each type of abuse was coded as follows: 0 = No experience abuse, and 1 = did experience abuse.

4.2.1.3 Psychosocial variables

Each participant was asked from whom they had received emotional support during their pregnancy. They were also asked whether they were in a relationship on that time and how satisfied they were in their relationship and a list of stressors they were facing at each time point. Only at the first-time point, the participants were asked if they had experienced any type of abuse i.e. physical, sexual or emotional.

Social support

Social support was assessed by two questions. On all three questionnaires, participants were asked whether they received emotional support and the sources of the emotional support. The two questions were “Do you have someone to turn to for emotional support?” If yes, then participants were asked from whom they received (their partner, mother, friends, female

relatives and other) and “Can you count on them to care about you no matter what?” For this analysis, these two questions were combined to make one composite variable and coded as social support. This composite variable was dichotomized as follows: 0 = low-level support (0-1 support), and 1 = high-level support (>1 support) of receiving social support.

Marital satisfaction

Each participant was asked if they were currently in a relationship, if yes, then how satisfied were they with the relationship. Responses from the second clause were transformed into two categories as follows: 0 = not satisfied, and 1 = very satisfied.

General stress

Women were asked a list of stressor they may have experienced which included 12 items: “being pregnant”, “partner/relationship”, “not enough money”, “children”, “family”, “where I live”, “health of my baby”, “birth of my baby”, “own health”, “work”, “school” and “other stressor”. All of these items were summed into a dichotomous variable as follow: 0 = low level (0-2 stressor), and 1 = high level (> 2 stressors) of stress.

4.2.1.4 Behavioural factors

Participants were asked about their behavioural activities such as physical activity, drinking alcohol, smoking, using other recreational drugs and data were coded at three-time points.

Exercise

Women were asked how frequently they engaged themselves in different types of physical activity such as walking, swimming etc. for a period of more than 20 minutes in a week in

last 1 month. The variable was then combined into two categories as follows: 0 = occasionally/never exercised, and 1 = everyday/2-3 times in week.

Smoking

On all three questionnaires, women were asked about their smoking habit during pregnancy. If they smoked, then women were further asked the frequency of smoking in last 1 month i.e. more than a pack per day. For this analysis, smoking was transformed into a dichotomous variable as follows: 0 = never smoker, and 1 = ever smoker.

Alcohol use

Mothers reported whether or not they had drunk alcohol during their pregnancy. If they did, they were asked about their drinking nature, drinking 5 or more drinks at one sitting (binge drinking), and drinking 1-2 drinks everyday in last month or if they had quit drinking alcohol during or before pregnancy. The variable was coded as a dichotomous variable as follows: 0 = never drinker, and 1 = ever drinker.

Drug use

Participants were asked whether they used illicit drugs such as cocaine, crystal meth, and marijuana during their pregnancy and if they did, how often did they use these recreational drugs in last 1 month or they had quit during or before pregnancy or never used. This variable was further categorized into a dichotomous variable as follows for further analysis: 0 = never drug user, and 1 = ever drug user.

4.2.2 Dependent variables

Obstetrical and biological complications of each participant were coded both at the initial interview and early postpartum. At time 1, Participants were asked to report their number of previous pregnancies. This included any complications related to earlier pregnancies, any anomalies or problem with the child, a general health history such as thyroid, heart disease, and urinary tract infection in previous pregnancy. Participants were also asked health problems (if they faced any) during their current pregnancy. Pregnancy complications mentioned during pregnancy were: Gestational diabetes, gestational hypertension, vaginal infection, urinary tract infection, edema/swelling, bleeding, abruption, thyroid problem etc. Data related to labour and delivery complications were also coded at time 3 which included induced or spontaneous labour, postpartum hemorrhage, infection, premature rupture of membrane. Additionally, participants were to report/mention about the birth outcomes such as the birth weight of the newborn, gestational week of the delivery etc.

4.2.2.1 Pregnancy complications

Participants were asked if they had experienced any kind of pregnancy complications. The majority of the participants reported they experienced at least one of the pregnancy complications. Most frequent complications included: gestational diabetes, gestational hypertension, edema, swelling, bleeding and abruption. Edema and swelling were combined into one variable, and abruption and bleeding were summed into one variable because the symptoms and causes of these complications were similar. Most commonly occurred complications were combined into a dichotomous variable: 0 = No or had at least one complication, and 1= had two or more complications.

Labour complications

Most common labour and delivery complications were reported by the participants included: infection, premature rupture of membrane, postpartum hemorrhage, and preterm labour. Most frequently occurred complications were combined into a dichotomous variable: 0 = No or had at least one complication, and 1= had two or more complications.

4.2.2.2 Birth outcomes

Preterm delivery, and low or high birth weight of the new-born were considered as poor birth outcomes for this analysis. Participants gestational week was recorded when they delivered the baby. This variable was transformed into a dichotomous variable as follows: gestational week <37 weeks = preterm delivery and gestational week \geq 37 weeks = normal/average delivery. Birth weight of the newborn baby was also reported by each participant during the interview. Initially, it was a continuous variable which was further categorized as 0 = Average for gestational age, 1 = Small for gestational age, and 2 = Large for gestational age. For this analysis, birth weight was transformed into a dichotomous variable 0 = average/ high birth weight, and 1= low birth weight.

4.3 Analysis

For this study, SPSS (PASW version 23) software was used. Descriptive statistics and frequencies of socio-demographic variables were done to understand the characteristics of study sample from Feelings in pregnancy and motherhood study. Bivariate analysis was performed to explore the primary associations between the independent and dependent

variables. In bivariate analysis, depression and anxiety were considered as primary predictors whereas other important covariates include maternal age, education, ethnicity, marital status, social support, stress, satisfaction with the current relationship, exercise, smoking, drinking alcohol, using other recreational drugs. All of these variables were measured both in early and later pregnancy which results in pregnancy complications and poor birth outcomes. For initial bivariate analysis, the p-value was set to ≤ 0.25 for testing significance. If one of these variables reached significance at the $p \leq 0.25$ level, that variable was further considered for testing moderating and mediating relationship. In order to analyze moderator and mediator variables, the p-value was set to ≤ 0.1 for significance level.

4.3.1 Moderating analysis

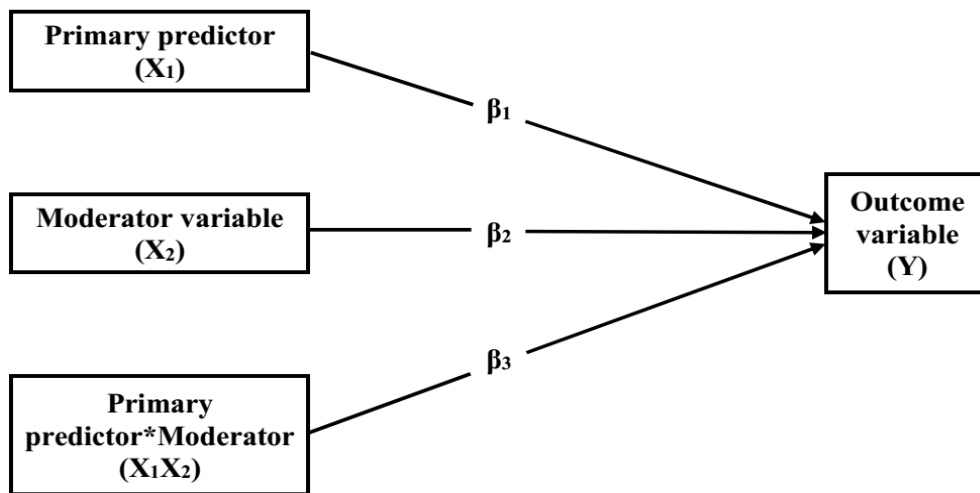
In order to test the moderating effect on the relationship between depression and anxiety and major pregnancy complications and poor birth outcomes, hierarchical regression procedures were performed. Multiple regression analysis was conducted for each dependent variables: Major pregnancy complications, major labour complications, preterm delivery and low birth weight. In statistical model, if the dependent variable is categorical, a single regression equation form for logistic regression can be written as follow:

$$\text{Log of the odds [Logit (p)]} = \text{Log} (p/1-p) = \beta_0 + \beta_1 X + \beta_2 M_o + \beta_3 X * M_o + \varepsilon$$

Where $(p/1-p)$ = Probability of Y, of an event/ Probability, Y of no event; β_0 is the intercept. β_1 is the coefficient relating the independent variable, X, to the outcome, Y, when $M_o = 0$, β_2 is the coefficient relating the moderator variable, M_o , to the outcome when $X = 0$, β_0 the intercept in the equation, and ε is residual in the equation.

In the hierarchical regression model, the order of entry was shown in figure 7. At step 1, the primary predictor variables i.e. depression and anxiety (at time 1) were entered into the regression equation for predicting pregnancy complications and birth outcomes (at time 3). At step 2, the moderating variables such as any type of abuse, age, ethnicity, education, income, marital status were entered into the regression equation. Finally, at step 3, the product term of predictor variable and moderator variables were included once they were significant at step 2. Product terms which were significant at step 3, were kept in the model, indicated a significant moderator effect.

Figure 7: Statistical path diagram for moderation effect



4.3.2 Mediating analysis

According to Barron and Kenny, mediating analysis involves four steps (performed with three regression equations) (Baron & Kenny, 1986). It is also suggested that regression coefficients are transformed and their corresponding p-values calculated for better comparability and interpretability when categorical independent and dependent variables are measured in different scales (MacKinnon & Dwyer, 1993).

To make the coefficient comparable across the equations following steps are followed. Each coefficient is multiplied by the standard deviation of the predictors variable in the equation and then dividing by the stand deviation of the outcome variable.

$$\text{Comp a} = a * \text{SD (X)} / \text{SD (M')}$$

$$\text{Comp b} = b * \text{SD (M)} / \text{SD (Y'')}$$

$$\text{Comp c} = c * \text{SD (X)} / \text{SD (Y')}$$

$$\text{Comp c}' = c' * \text{SD (X)} / \text{SD (Y'')}$$

(') is added to show the different scales among the variables.

Again, to solve the variances of Y', M' and Y'' Mackinnon and Dwyer's equations are followed. The equations are as below:

$$\text{Var (Y')} = c^2 * \text{Var (X)} + \pi^2 / 3$$

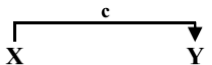
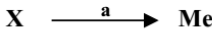
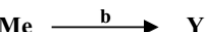
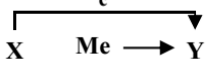
$$\text{Var (M')} = a^2 * \text{Var (X)} + \pi^2 / 3$$

$$\text{Var (Y'')} = c'^2 * \text{Var (X)} + b^2 * \text{Var (M)} + 2 * b * c' * \text{Cov (X,M)} + \pi^2 / 3$$

Once the regression coefficients are transformed, the corresponding p-values are calculated to interpret the significant mediation effects in both direct and indirect pathways (MacKinnon & Dwyer, 1993). Typical mediation steps are described as below.

The first step is to show there is a significant relationship between the predictor and outcome. The second step is to show that the predictor variable must be related to the mediator variable. The third step is to show that the mediator variable is related to the outcome variable and it is estimated controlling for the effects of the predictor on the outcome. The final step is to show that the coefficient relating to the independent variable and the dependent variable is larger (in absolute value) than the coefficient relating the independent variable and the dependent variable in the regression model with both the independent and the mediating variable included (MacKinnon, Fairchild, & Fritz, 2007). If the independent variable is no longer significant ($p\text{-value} > 0.1$ in this study) while controlling for the mediator variable, then the result supports full mediating effect. If the independent variable is found to be still significant ($p < 0.1$) along with the mediator variable in the regression model, the finding supports a partial mediating effect.

The basic steps to establish mediating effects are as below:

Analysis		Visual Depiction
Step 1	A simple regression analysis is conducted with X predicting Y to test for path c alone	
Step 2	A simple regression analysis is done with X predicting M to test for path a	
Step 3	A simple regression analysis is done with M predicting Y to test the significance of path b alone	
Step 4	A multiple regression analysis is performed with X and M predicting Y	

For this study, potential mediator variables such as physical activity, drinking alcohol, smoking, using other recreational drugs, social support, stress and satisfaction with the relationship at later pregnancy (time 2) were considered to predict pregnancy and labour complications and poor birth outcomes (time 3).

A series of logistic regression analyses were performed to test significant moderator and mediator variables. The Wald chi-square test was used to check the significance of potential variables. Statistical significance was set at $p \leq 0.1$, which is a more liberal cut-point for assessing statistical significance than the usual cut point of $p < .05$. The interest in this study is to reveal any potential mediator and moderating role(s) for selected risk factors that be involved in the relationship between depression/anxiety and pregnancy and birth outcomes. For this reason, it was determined that a more liberally set p-value is justifiable.

CHAPTER 5: Results

This chapter describes the results of the secondary analysis of the data which was collected for the Feelings in Pregnancy and Motherhood study (FIP). In this longitudinal population-based study, of the initial 646 women who were recruited, thirty-five women were lost to follow-up and twenty-one women did not finish the study mostly due to miscarriages and stillbirth. However, 646 (100%) women completed the questionnaire at early pregnancy (time 1), and 596 (91.8%) women completed the study at early postpartum (time 3).

5.1 Participants characteristics

Table 1 presents the frequency of participants' socio-demographic characteristics. A majority of the women (77.4%) were more than 25 years' old. Most of the women were either married or have a common-law partner (90.2%) compared to single (9.8%). The below table also shows that only 8.5 % of participants were found to be Aboriginal. Moreover, the majority of the participants completed grade 12 or higher education (94.9%) and more than half of the women had a household income of \$40,000 or greater.

Table 1: Socio-demographic characteristics of study population

(n = 646)

Variables	% (n)
Maternal age	
≤ 25 years' old	22.6 (146)
>25 years' old	77.4 (500)
Marital status	
Married/Common-Law	90.2 (583)
Single/Divorced/Widowed	9.8 (63)
Ethnicity	
Aboriginal	8.5 (55)
Non-aboriginal	91.3 (590)

Variables	% (n)
Education	
<Grade 12	5.0 (32)
Grade 12 or over	94.9 (613)
Income	
< \$40,000	31.3 (202)
≥ \$40,000	68.7 (444)

Table 2 presents the prevalence of depression and anxiety in the second and late pregnancy. The prevalence of depression was 14.1% (91) in early pregnancy whereas it was 10.2 % (61) in late pregnancy. On the other hand, about half of the women (47.1 %) experienced an anxiety disorder in early pregnancy which decreased to 38.4 % in late pregnancy.

Table 2: Prevalence of depression and anxiety during pregnancy

	Early pregnancy n = 646 % (n)	Late pregnancy n = 605 % (n)
Depression (Score of ≥12)	14.10% (91)	10.20% (61)
Anxiety (Score of ≥4)	47.10% (304)	35.80% (231)

Figure 8 shows the behavioural factors of the study participants. The figure shows that about 54.4% (350) women were engaged in physical activity (every day or 2-3 times a week) in early pregnancy whereas more than half of the women (56.6%, n = 340) reported that they engaged in physical activity in late pregnancy.

Figure 8: Percentage of exercise during pregnancy

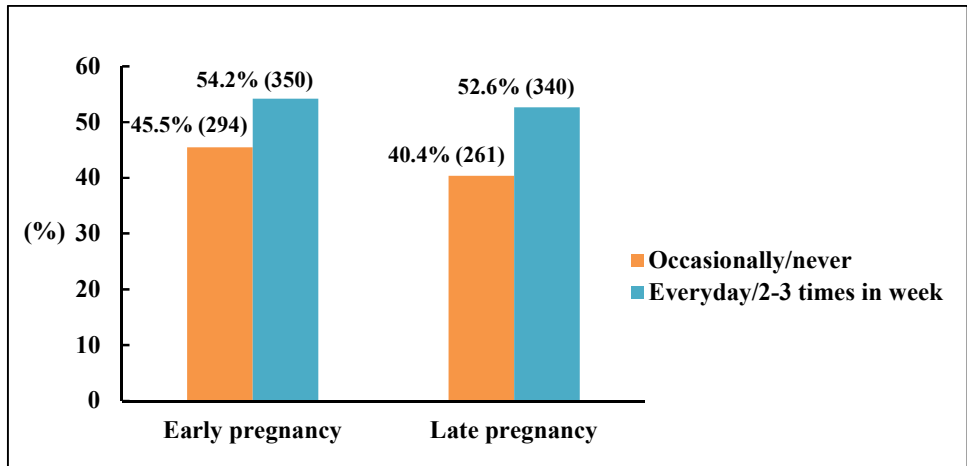


Figure 9 shows the frequency of risky behaviours such as smoking, alcohol consumption, and using drugs in the second and late pregnancy. The figure represents that only 11.8 % (76) women had a smoking habit during their early pregnancy while 9.6% (62) women reported their smoking habit in late pregnancy. Likewise, a small percentage of participants engaged/involved themselves different types in risky behaviours such as drinking alcohol and using recreational drugs in the early and late pregnancy.

Figure 9: Percentage of poor health behaviours during pregnancy

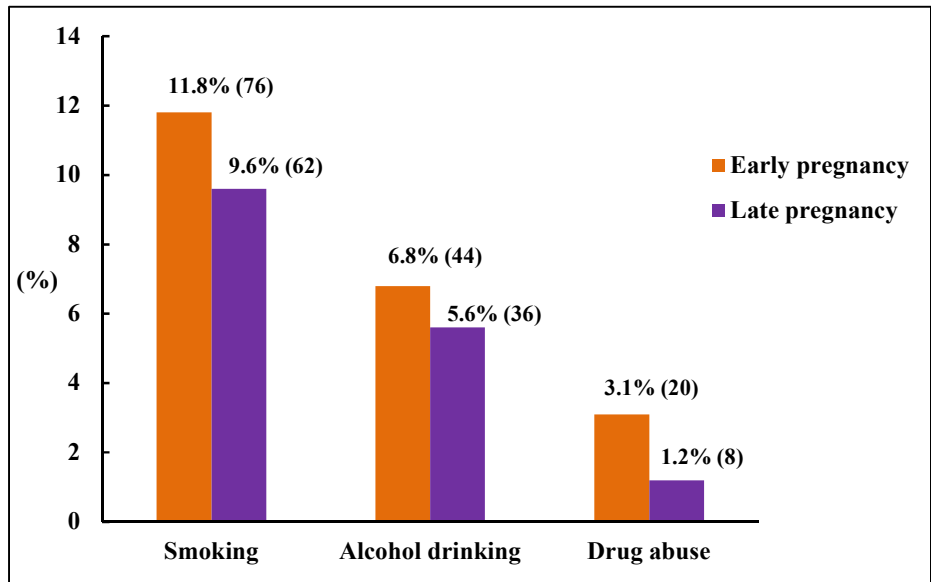


Figure 10 presents that different types of abuse experienced by the women in early pregnancy. Half of the women 52% (336) reported experiencing emotional abuse during or before pregnancy whereas a small number of women also faced physical abuse 28.8% (186) and sexual abuse 23.5% (152) either by their intimate partner or family members in early pregnancy.

Figure 10: Frequency of any form of abuse during pregnancy

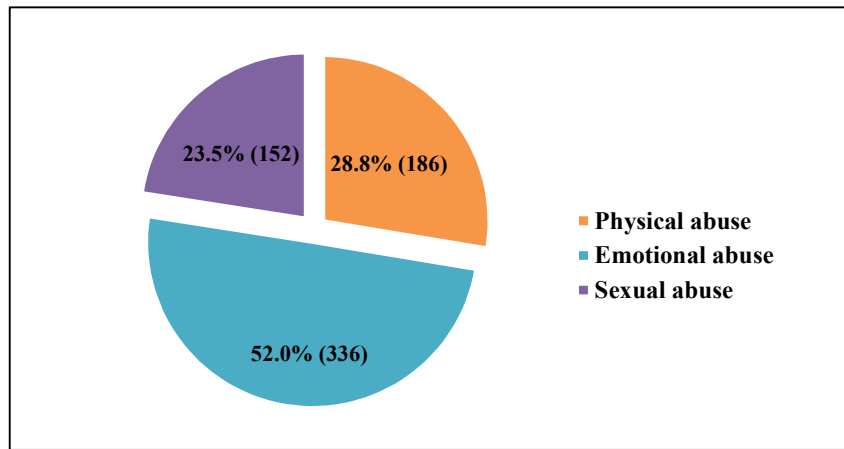


Figure 11 depicts the frequency of major pregnancy and labour complications among the study participants; 22.6 % women reported to have two or more pregnancy complications and 3.6% women also experienced labour complications.

Figure 11: Major pregnancy and labour complications

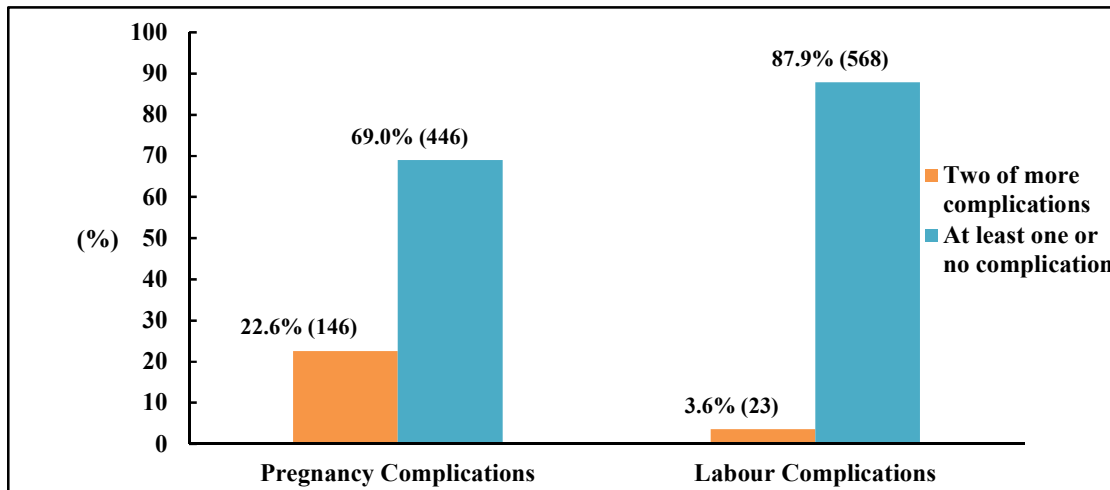


Table 3 shows the birth outcomes such as preterm delivery and birth weight, only 5.7 % women had preterm delivery i.e., delivery within 37 weeks whereas 7.6 % women delivered newborn with low birth weight.

Table 3: Birth outcomes

(n = 586)

Variables	% (n)
Preterm delivery (< 37 weeks)	
Yes	5.7 (37)
No	85.0 (549)
Birth weight	
Average/High	82.8 (535)
Low	7.6 (49)

5.2 Bivariate analysis

Table 4 shows the bivariate analysis of the sample in early pregnancy and in late pregnancy. Bivariate analysis was performed to find out the significant relationship between depression and anxiety and pregnancy complications and birth outcomes. Socio-demographic factors such as the age of the mother, education attainment, the level of income, ethnicity and marital status measured at early pregnancy were also considered as potential variables in the analysis. In addition, behavioural and psychosocial factors such as poor physical activity, lack of social support, smoking habit, drinking alcohol, stress etc. measured in early pregnancy and in late pregnancy were taken into consideration as potential predictors on the primary association. For bivariate analysis, the p value was set as ≤ 0.25 for testing significance. Variables those reached the initial cut-off significance of $p \leq 0.25$ were selected for further analysis.

Table 4: Bivariate associations between potential risk factors in early pregnancy (time 1) with major pregnancy complications and birth outcomes in early postpartum (time 3)

Predictor variable	Outcome variable		Significance level (<i>p</i> value)
	1 or no pregnancy complication (%)	2 or more pregnancy complications (%)	
Depression in early pregnancy			
No depression	397 (67.10)	119 (20.10)	0.019
Depression	49 (8.30)	27 (4.60)	
Anxiety in early pregnancy			
No anxiety	252 (42.60)	71 (12.00)	0.097
Anxiety	194 (32.80)	75 (12.70)	
Ethnicity			
Aboriginal	22 (3.70)	17 (2.90)	0.005
Non-aboriginal	424 (71.60)	129 (21.80)	
Education			
Less than grade 12	12 (2.00)	7 (1.20)	0.205
12 grade or over	434 (73.40)	138 (23.40)	
Exercise			
Occasionally/never	185 (31.40)	82 (13.90)	0.002
Everyday/2-3 times in week	259 (43.90)	64 (10.80)	
Smoking status			
Ever smoker	34 (5.80)	24 (4.10)	0.002
Never smoker	412 (69.70)	121 (20.50)	
Satisfaction with relationship			
Not satisfied	39 (6.70)	19 (3.30)	0.127
Very satisfied	397 (68.70)	123 (21.30)	
Social Support			
Low support	69 (11.70)	29 (4.90)	0.215
High support	374 (63.60)	116 (19.70)	
Emotional abuse			
Yes	218 (48.90)	84 (57.50)	0.069
No	228 (51.10)	62 (42.50)	
Sexual abuse			
Yes	88 (19.70)	47 (32.20)	0.002
No	358 (80.30)	99 (67.80)	
Physical abuse			
Yes	115 (25.80)	49 (33.60)	0.068
No	331 (74.20)	97 (66.40)	

Predictor variable	Outcome variable		Significance level (<i>p</i> value)
	Major labour complications		
	1 or no labour complication (%)	2 or more labour complications (%)	
Ethnicity			
Aboriginal	35 (5.90)	4 (0.70)	0.033
Non-aboriginal	533 (90.20)	19 (3.20)	
Marital status			
Single/divorced/widowed	50 (8.50)	0 (0.00)	0.137
Married/common-law	518 (87.60)	23 (3.90)	
Sexual abuse			
Yes	133 (23.40)	1 (4.30)	0.032
No	435 (76.60)	22 (95.7)	
Social support			
Low support	92 (15.70)	6 (1.00)	0.218
High support	472 (80.40)	17 (2.90)	
Stress			
Low stress	174 (30.20)	13 (2.30)	0.012
High stress	380 (65.90)	10 (1.70)	
Exercise			
Occasionally/never	251 (42.60)	16 (2.70)	0.017
Everyday/2-3 times in week	315 (53.50)	7 (1.20)	
Preterm delivery			
	No (%)	Yes (%)	
Anxiety in early pregnancy			
No anxiety	297 (50.70)	24 (4.10)	0.203
Anxiety	252 (43.00)	13 (2.20)	
Using other drugs			
Ever drug user	12 (2.10)	3 (0.50)	0.028
Never drug user	535 (91.60)	34 (5.80)	
Birth weight			
	Average/high birth weight (%)	Low birth weight (%)	
Marital status			
Single/divorced/widowed	40 (6.80)	7 (1.20)	0.094
Married/common-law	495 (84.80)	42 (7.20)	
Income level			
Less than \$40,000	150 (25.70)	18 (3.10)	0.198
\$40,000 or more	385 (65.90)	31 (5.30)	

Table 5 represents the significant bivariate associations between independent and dependent variables in late pregnancy. In late pregnancy, behavioural and psycho-social factors such as physical activity, smoking habit, using recreational drugs, lack of social support, stress, satisfaction with current relationship were found as significant predictors along with major depression and anxiety as primary predictor.

Table 5: Bivariate associations between potential risk factors in late pregnancy (time 2) with major pregnancy complications and birth outcomes in early postpartum (time 3)

Predictor variable	Outcome variable		Significance level (<i>p</i> value)
	Major pregnancy complications 1 or no pregnancy complication (%)	2 or more pregnancy complications (%)	
Depression in late pregnancy			
No depression	403 (68.10)	121 (20.40)	0.014
Depression	43 (7.30)	25 (4.20)	
Anxiety in late pregnancy			
No anxiety	280 (48.40)	81 (14.00)	0.158
Anxiety	157 (27.20)	60 (10.40)	
Exercise			
Occasionally/never	180 (31.30)	68 (11.80)	0.154
Everyday/2-3 times in week	255 (44.30)	73 (12.70)	
Smoking status			
Ever smoker	35 (6.10)	18 (3.10)	
Never smoker	400 (69.40)	123 (21.40)	
Stress			
Low stress	194 (34.00)	44 (7.70)	0.005
High stress	237 (41.60)	95 (16.70)	
Major labour complications			
	1 or no labour complication (%)	2 or more labour complications (%)	
Depression in late pregnancy			
No depression	505 (85.40)	18 (3.00)	0.153
Depression	63 (10.70)	5 (0.80)	

Predictor variable	Outcome variable		Significance level (<i>p</i> value)
	Major labour complications		
	1 or no labour complication (%)	2 or more labour complications (%)	
Anxiety in late pregnancy			
No anxiety	344 (59.60)	15 (2.60)	0.126
Anxiety	214 (37.10)	4 (0.70)	
Social support			
Low support	6 (1.00)	1 (0.20)	0.102
High Support	550 (95.70)	18 (3.10)	
Preterm delivery			
	No (%)	Yes (%)	
Depression in late pregnancy			
No depression	490 (83.60)	28 (4.80)	0.013
Depression	59 (10.10)	9 (1.50)	
Birth weight			
	Average/high birth weight (%)	Low birth weight (%)	
Depression in late pregnancy			
No depression	477 (81.70)	40 (6.80)	0.114
Depression	58 (9.90)	9 (1.50)	
Exercise			
Occasionally/never	228 (40.10)	16 (2.80)	0.201
Everyday/2-3 times in week	294 (51.70)	31 (5.40)	
Smoking status			
Ever smoker	40 (7.00)	11 (1.90)	0.000
Never smoker	481 (84.70)	36 (6.30)	
Using drugs			
Ever drug user	4 (0.70)	2 (0.40)	0.025
Never drug user	518 (91.00)	45 (7.90)	
Satisfaction with relationship			
Not satisfied	65 (11.80)	2 (0.40)	0.117
Very satisfied	443 (80.40)	41 (7.40)	

5.3 Mediation analysis

According to Barron and Kenny, mediation analysis involves four steps. Multiple regression analyses were done to find out potential mediator variables (Kong, Zhao, & You, 2013; Rahman et al., 2014). First, the outcome variable is regressed on the predictor to show that there is an effect to mediate. Second, the mediator variable is regressed on the predictor variable through mediation chain. Third, the outcome variable is regressed on both the predictor and mediator variables. The four steps are stated in terms of descriptive non-zero coefficients (Frazier et al., 2004). Hence, it is suggested that the fourth step is not intended to test the statistical significance of the mediation effect (Wu & Zumbo, 2008).

In this study, behavioural and psychosocial factors such as poor physical activity, smoking habit, alcohol consumption, lack of social support, stressor etc. measured in late pregnancy were considered as important mediators of the relationship between depression and anxiety and major pregnancy complications and birth outcomes. A total of 7 mediator variables were tested for mediation analysis and only one mediator, i.e. general stress, was found to have significant mediation effect among all. The presence of different types of stressors in late pregnancy (time 2) was identified in two significant mediating pathways for both depression status and anxiety measured in early pregnancy (time 1) in predicting pregnancy complications in early postpartum (time 3).

Table 6: Mediating effects of stress in late pregnancy on the relationship between depression in early pregnancy and major pregnancy complications

Variable	Estimated β	<i>p</i> value
Direct Effect, c, (Step 1)		
Depression in early pregnancy (Time 1)	0.261	0.020 (≤ 0.1)
Indirect Effect, a, (Step 2)		
Depression in early pregnancy (Time 1)	0.130	0.006 (≤ 0.1)
Indirect Effect (Step 3)		
Depression in early pregnancy, c', (Time 1)	0.116	0.045 (≤ 0.1)
Stress in late pregnancy, b, (Time 2)	0.101	0.010 (≤ 0.1)

The table 6 shows the mediating effect of stress and findings of each step. The table also represents the partial mediation effect of stressor measured in late pregnancy (time 2) in resulting pregnancy complications at early postpartum period (time 3) among women who were depressed during early pregnancy (time 1). At step 1, depression in early pregnancy predicted major pregnancy complications which were a direct pathway of the primary relation (effect c). At step 2, depression measured in early pregnancy significantly predicted the presence of different stressors (effect a) while the presence of stressors also resulted in pregnancy complications in step 3 (effect b). Finally, depression was significantly associated with pregnancy complications after addition of stress in the final model (effect c') which indicated partial mediation effect on the indirect pathway.

The figure 12 shows the mediation pathway of general stress. The presence of different types of stressors (2 or more) mediated the relationship between depression and pregnancy complications in a causal pathway. The study hypothesized that women with major depression, who had two or more stressors during their pregnancy were more likely to experience two or more pregnancy complications than non-depressed women.

Figure 12: Partial mediation effect of stress in late pregnancy on the relationship between depression in early pregnancy and major pregnancy complications

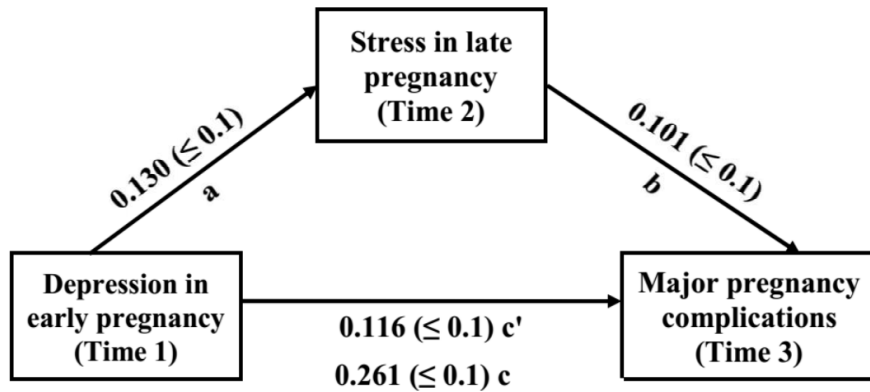


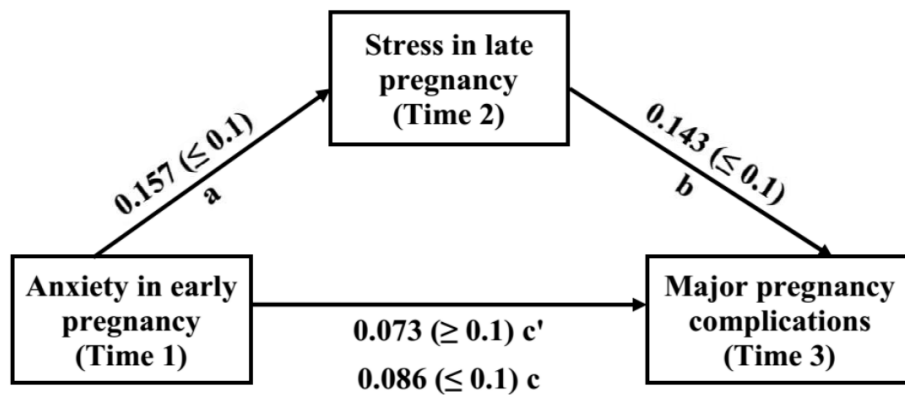
Table 7: Mediating effects of stress in late pregnancy on the relationship between anxiety in early pregnancy and major pregnancy complications

Variable	Estimated β	<i>p</i> value
Direct Effect, c, (Step 1)		
Anxiety in early pregnancy (Time 1)	0.086	0.076 (≤ 0.1)
Indirect Effect, a, (Step 2)		
Anxiety in early pregnancy (Time 1)	0.157	0.001 (≤ 0.1)
Indirect Effect (Step 3)		
Anxiety in early pregnancy, c', (Time 1)	0.073	0.187
Stress in late pregnancy, b, (Time 2)	0.143	0.006 (≤ 0.1)

Steps of mediation analysis of stress are presented in table 7. Presence of two or more stressors in late pregnancy (time 2) was identified as a potential mediator variable in the relationship between anxiety and pregnancy complications. At step 1, anxiety in early pregnancy (time 1) was associated with pregnancy complications in early postpartum (time 3) (effect c). At step 2, anxiety also predicted to cause stress in late pregnancy (effect a). At step 3, the presence of stressors in late pregnancy (time 2) significantly predicted pregnancy

complications (effect b). Lastly, anxiety in early pregnancy was found not a significant predictor of pregnancy complications when stress in late pregnancy was added to the final model (effect c'); indicating a full mediation pathway between anxiety in early pregnancy and pregnancy complications.

Figure 13: Full mediation effect of stress in late pregnancy on the relationship between anxiety in early pregnancy and major pregnancy complications



5.4 Moderation analysis

Hierarchical multiple regression analyses were conducted for moderation analysis. Socio-demographic characteristics of the participants such as maternal age, education, income level, marital status, ethnicity and any form of abuse i.e. physical or emotional abuse measured in early pregnancy (time 1) were considered as a potential predictor for each outcome variable. The table shows the moderation effect of these risk factors at early pregnancy which influenced the relationship between depression and anxiety and pregnancy complications and birth outcomes.

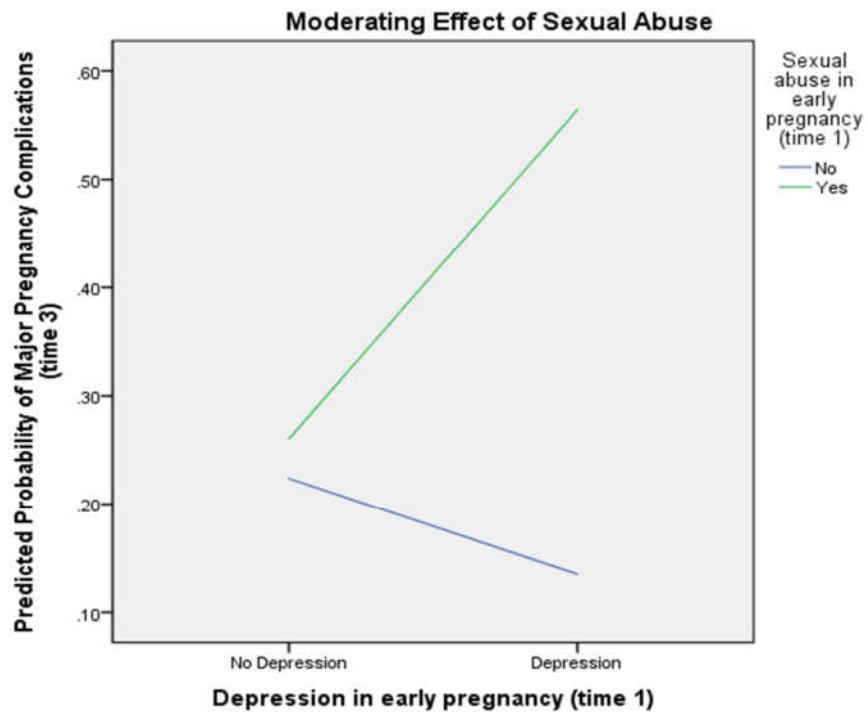
For moderation analysis, eight variables were tested to find out significant moderation effect whereas two variables were found to have the potential effect to predict pregnancy complications among depressed mothers in early pregnancy (time 1). For this study, a significance level of Wald chi-square P value was set as ≤ 0.1 .

Table 8: Moderating effects of potential risk factors in early pregnancy on predicting major pregnancy complications

Variable	Major Pregnancy Complications		
	Estimated β	<i>p</i> value	Odds Ratio (95% C.I.)
Sexual abuse	0.200	0.443	1.221 (0.733, 2.034)
Depression in early pregnancy (time 1)	-0.613	0.216	0.542 (0.205, 1.430)
Sexual abuse*depression	1.914	0.003 (≤ 0.1)	6.782 (1.953, 23.548)
Sexual abuse	0.209	0.532	1.232 (0.640, 2.371)
Anxiety in early pregnancy (time 1)	0.051	0.823	1.053 (0.672, 1.650)
Sexual abuse*anxiety	0.752	0.089 (≤ 0.1)	2.121 (0.891, 5.051)
Marital status	-0.699	0.154	0.497 (0.191, 1.298)
Anxiety in early pregnancy (time 1)	-0.767	0.241	0.464 (0.129, 1.674)
Marital status*anxiety	1.183	0.084 (≤ 0.1)	3.265 (0.854, 12.843)

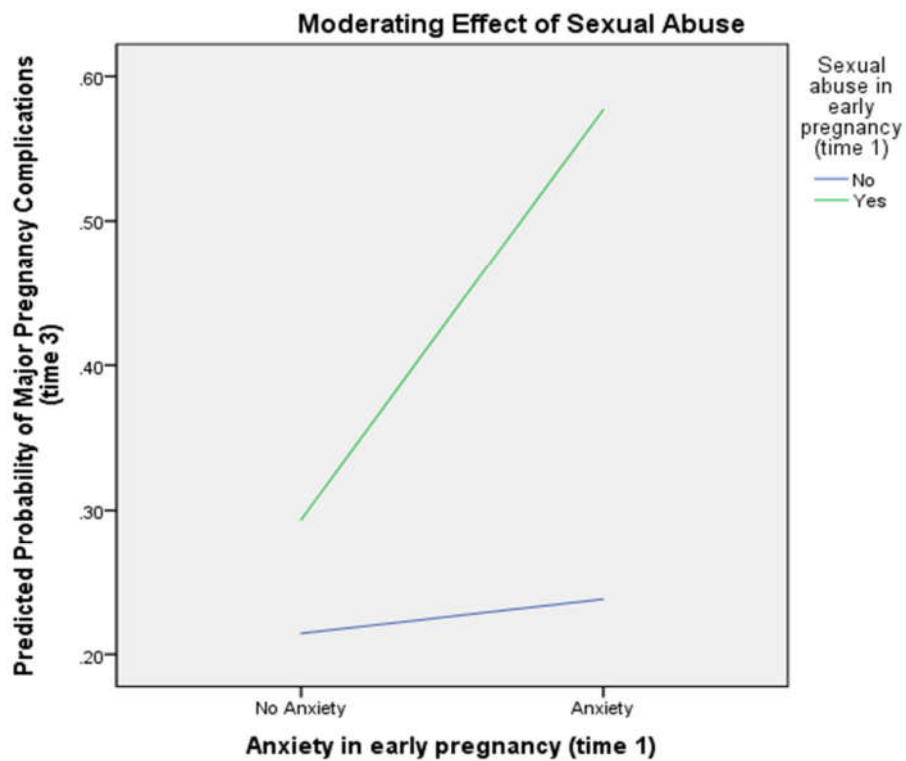
In moderation analysis, first, significant moderator was sexual abuse which moderated the effect of both depression and anxiety in early pregnancy (time 1) to cause pregnancy complications in early postpartum (time 3). Women who were sexually abused and who reported depression in early pregnancy were more likely to report two or more pregnancy complications than women who were not sexually abused.

Figure 14: Moderation effects of sexual abuse on the relationship between depression status in early pregnancy and major pregnancy complications in early postpartum



Sexual abuse was also identified as a potential moderator of the relationship between anxiety and major pregnancy complications. Amongst women who experienced sexually abuse those who reported anxiety during their early pregnancy (time 1) were more likely to report pregnancy complications (time 3) than women who were not sexually abused.

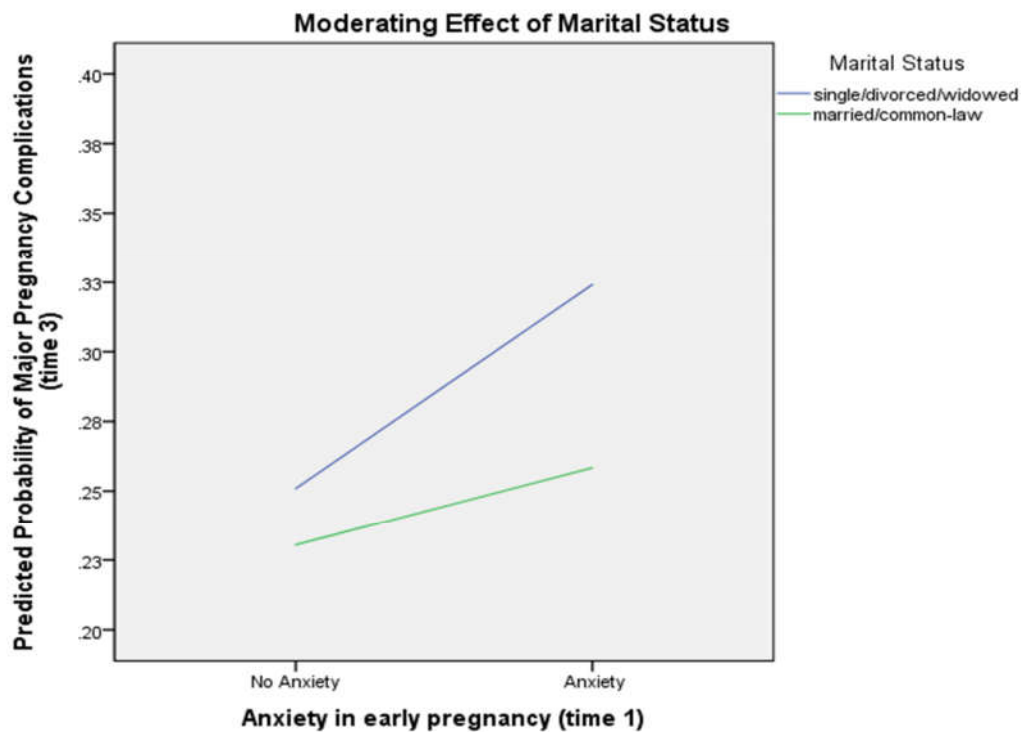
Figure 15: Moderation effects of sexual abuse on the relationship between anxiety in early pregnancy and major pregnancy complications in early postpartum



The third significant moderator was marital status which influenced the association between anxiety and pregnancy complications. Women who were not partnered at the time of the study (single, divorced or widowed) and who reported anxiety during early pregnancy (time 1) were more likely to report two or more pregnancy complications in early postpartum (time 3) compared to those who were either married or in common-law and reported anxiety.

Other socio-demographic variables such as ethnic background, the level of income, education, the age of the mother were also analysed but did not show significant moderation effects on the primary relationship.

Figure 16: Moderation effects of marital status on the relationship between anxiety in early pregnancy and major pregnancy complications in early postpartum



Hierarchical multiple regression analyses were also performed for each dependent variable i.e. major pregnancy and labour complications, preterm delivery and birth weight in early postpartum period. To find out significant moderator variables in late pregnancy (time 2), socio-demographic variables were tested. While looking at the moderating effect of potential risk factors in late pregnancy, four possible factors were identified to have significant moderation impact on the relationship between depression and anxiety and pregnancy complications and poor birth outcomes.

Table 9: Moderating effects of potential risk factors in late pregnancy on predicting major pregnancy complications

Variable	Major pregnancy complications		
	Estimated β	<i>p</i> value	Odds ratio (95% C.I.)
Sexual abuse	0.420	0.082	1.522 (0.947, 2.446)
Depression in late pregnancy (time 2)	0.135	0.723	1.145 (0.542, 2.418)
Sexual abuse*depression	1.053	0.074 (≤ 0.1)	2.867 (0.903, 9.100)
Sexual abuse	0.319	0.295	1.376 (0.758, 2.499)
Anxiety in late pregnancy (time 2)	-0.001	0.997	0.999 (0.621, 1.608)
Sexual abuse*anxiety	0.729	0.100 (≤ 0.1)	2.073 (0.869, 4.945)
Maternal age	-0.409	0.272	0.664 (0.320, 1.378)
Anxiety in late pregnancy (time 2)	0.081	0.719	1.085 (0.697, 1.688)
Maternal age*anxiety	0.926	0.066 (≤ 0.1)	2.525 (0.941, 6.772)
Preterm delivery			
Emotional abuse	-0.192	0.622	0.825 (0.385, 1.771)
Depression in late pregnancy (time 2)	-1.862	0.001	0.155 (0.053, 0.457)
Emotional abuse*depression	1.708	0.046 (≤ 0.1)	5.520 (1.032, 29.518)
Birth weight			
Ethnicity	0.810	0.433	2.248 (0.297, 17.015)
Depression in late pregnancy (time 2)	2.565	0.039	13.000 (1.143, 18.819)
Ethnicity*depression	-2.277	0.085 (≤ 0.1)	0.103 (0.008, 1.374)
Emotional abuse	-0.533	0.189	0.587 (0.265, 1.301)
Anxiety in late pregnancy (time 2)	-0.583	0.263	0.588 (0.201, 1.548)
Emotional abuse*anxiety	1.185	0.081 (≤ 0.1)	3.272 (0.862, 12.415)

Like early pregnancy (time 1), experiencing sexual abuse before or during pregnancy was found to have a significantly moderated effect on the relationship between depression in late pregnancy (time 2) and pregnancy complications in early postpartum (time 3). Pregnant women who had experienced sexual abuse before or during pregnancy (time 1) and reported depression in late pregnancy (time 2) were more likely to have pregnancy complications (time 3) than those who did not experience sexual abuse. Similarly, sexual abuse also showed moderating effect on predicting pregnancy complications among women who had anxiety.

Figure 17: Moderation effects of sexual abuse on the relationship between depression status in late pregnancy and major pregnancy complications in early postpartum

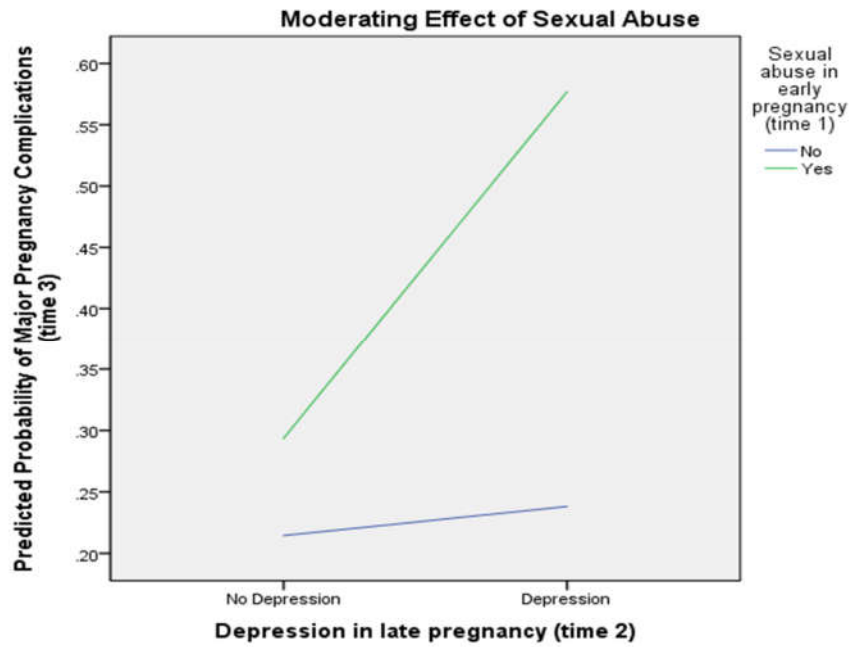
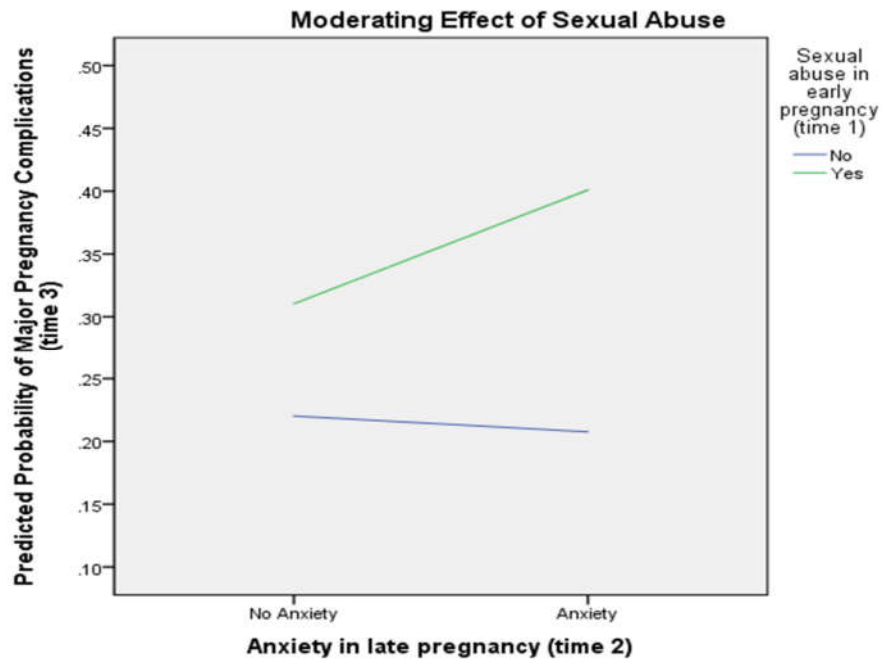
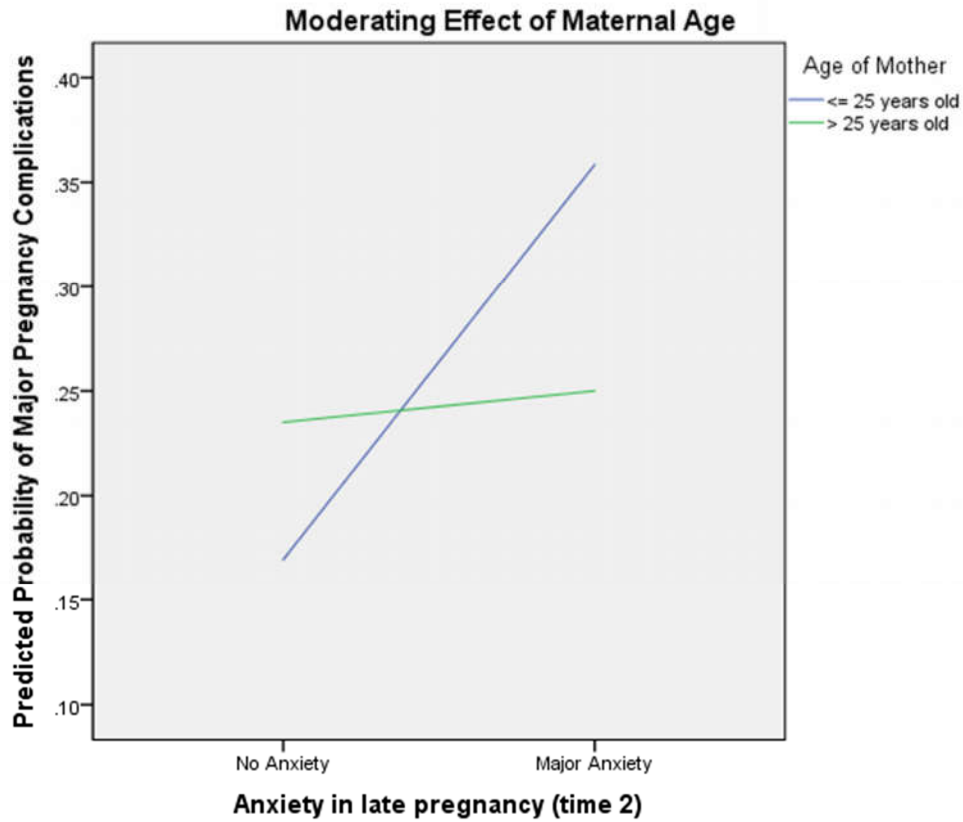


Figure 18: Moderation effects of sexual abuse on the relationship between anxiety in late pregnancy and major pregnancy complications in early postpartum



Second potential moderator in late pregnancy (time 2) was the age of the mother. Maternal age showed significant moderation effect on the association between anxiety in late pregnancy (time 2) and pregnancy complications in early postpartum (time 3). Mothers who were younger (less than 25 years) who also reported anxiety in late pregnancy (time 2) were more likely to have pregnancy complications (time 3) compared with mothers who were older than 25 years.

Figure 19: Moderation effects of age of the mother on the relationship between anxiety in late pregnancy and major pregnancy complications in early postpartum



Third moderator variable was emotional abuse which showed moderation effect for both preterm delivery and birth weight. For preterm delivery, emotional abuse in early pregnancy (time 1) moderated the relationship between depression in late pregnancy (time 2) and preterm delivery in early postpartum (time 3). Mothers who reported emotional abuse in early pregnancy (time 1) and who reported depression in late pregnancy (time 2) were more intended to have preterm delivery (< 37 weeks) compared with the mothers who were not emotionally abused. Furthermore, emotional abuse was also found as a potential moderator for the low birth weight of the newborn. Women who were not emotionally abused in early

pregnancy (time 1) but reported anxiety in late pregnancy (time 2) were more likely to deliver low birth weight baby compared with women who did experience emotional abuse.

Figure 20: Moderation effects of emotional abuse on the relationship between depression status in late pregnancy and preterm delivery in early postpartum

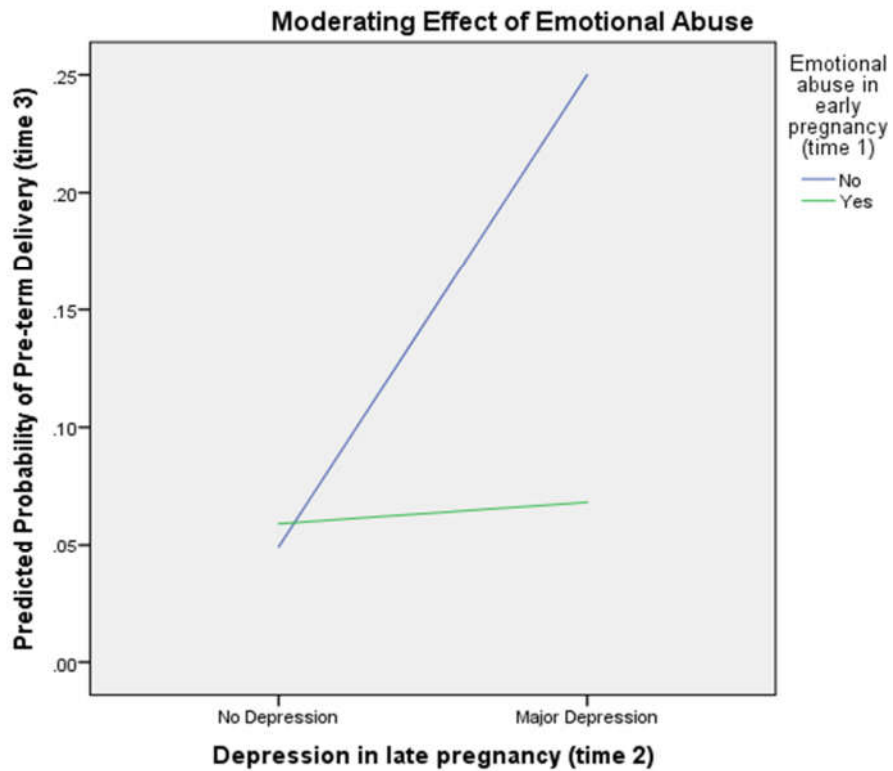
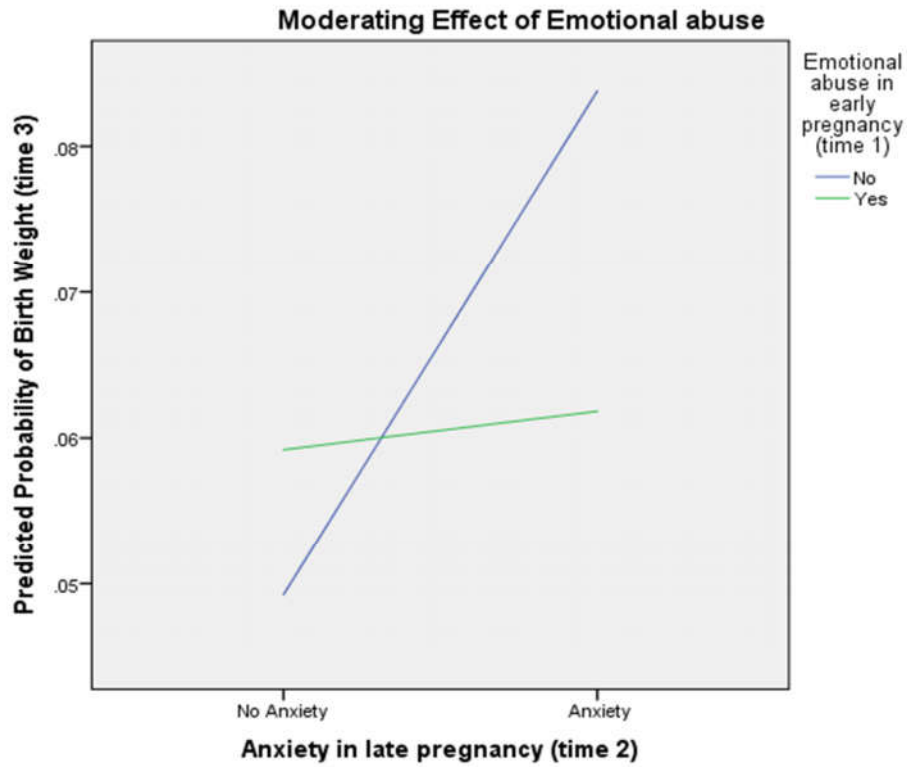
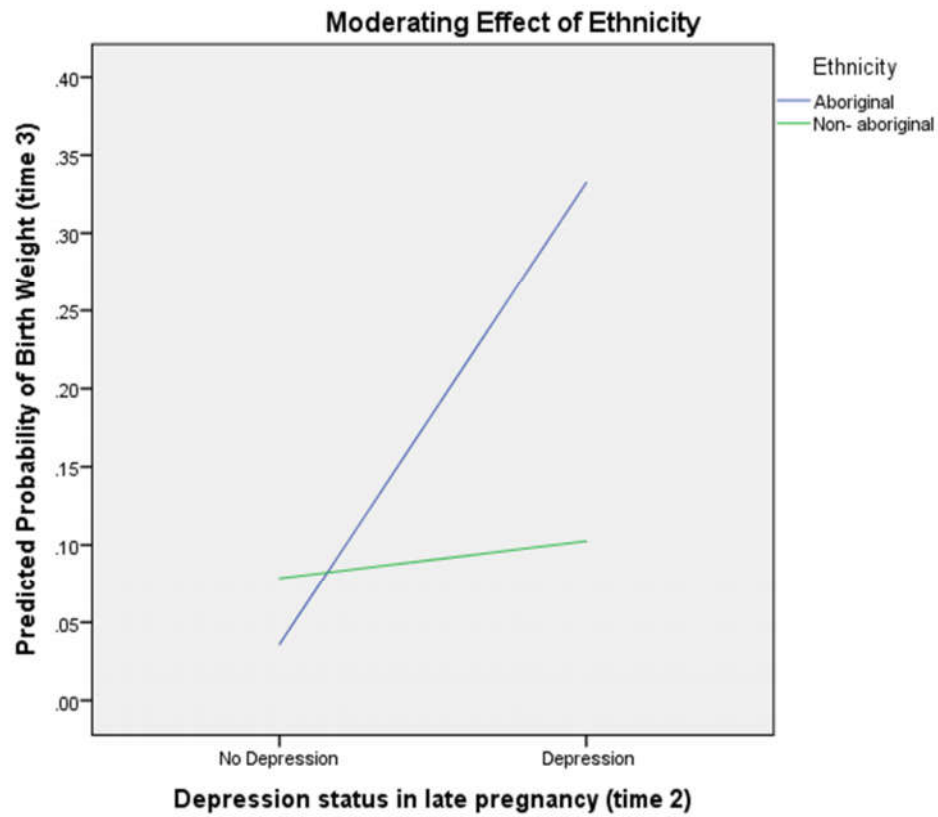


Figure 21: Moderation effects of emotional abuse on the relationship between anxiety in late pregnancy and birth weight in early postpartum



Finally, ethnicity was identified as modifiable factors to predict the low birth weight of the newborn. The ethnic background of the participants significantly influenced the relationship between depression in late pregnancy and birth weight of the newborn. Women who were Aboriginal and also reported depression in their late pregnancy (time 2) were more likely to deliver low birth weight baby (time 3) compared with women who were not Aboriginal.

Figure 22: Moderation effects of ethnicity on the relationship between depression status in late pregnancy and birth weight in early postpartum



CHAPTER 6: Discussion

This chapter presents a discussion of the study findings and their implications. The chapter presents the outcome of each research question and end up with strengths, limitations, practical implications, and recommendations. This thesis investigated the moderating and mediating effects of certain potential risk factors on the relationship between antenatal depression and anxiety resulting in poor pregnancy outcomes among a cohort of pregnant women in Saskatchewan. To examine the moderating and mediating effects on this particular relationship, socio-demographic factors, poor health and risky behaviours, and psychosocial factors were considered as potential predictors.

6.1 Summary of the study findings

In this cohort study, the prevalence of major depression was 14.1% and 10.4% in early pregnancy and late pregnancy, respectively, which was consistent with previous studies (Adewuya et al., 2007; Pearlstein, 2015). Another recent study also concluded about 18% women experience depression during their pregnancy (Szegda et al., 2013). The prevalence of depression in our sample was more frequent in early pregnancy than the late pregnancy which was similar to another finding (Engberg et al., 2015). Depression and anxiety are common mood disorders among women which are more frequent in their reproductive years. The present study examined the prevalence of both depression and anxiety in the early and late pregnancy. The prevalence of anxiety of this group was 47.1% and 38.4% in early and late pregnancy, respectively, which was similar to a prior study (Schwartz et al., 2015). Although prevalence of anxiety reported in the literature also varies widely ranging from 9.1% -59.5% (Kang et al., 2016), our results were within the range. Overall, in this longitudinal study, the majority of the participants were 25 years old or more, had higher

income level and also highly educated whereas low income coupled with the lower level of education may have potential impact in developing depression during pregnancy (Rahman et al., 2014; Tabet et al., 2016).

While epidemiological studies have reported a link between depression and pregnancy complications, findings have been inconsistent (Dole et al., 2003). Our results found that women with major depressive disorder were suffering from at least one or more of obstetric complications which were similar to other findings (Preti et al., 2000). Furthermore, our study findings indicated that certain labour complications such as preterm labour, postpartum haemorrhage, pre-mature rupture of the membrane, infections were also predominant which were related to depression among women. Like depression, our results show that certain pregnancy complications strongly associated with anxiety. This finding was consistent with the literature as anxiety was a potential predictor of gestational hypertension and pre-eclampsia (Kurki et al., 2000). Similar to our results, a study in France also reported that women who were diagnosed with anxiety were more likely to develop pregnancy complication compared with women who had no anxiety (Karaçam & Ançel, 2009).

Most studies related to depression or anxiety have focused on the risk factors either as an independent risk factor or protective factor in developing depression or anxiety during pregnancy which in turn lead to pregnancy complications and negative birth outcomes. There is limited research exploring the underlying mechanisms of these risk factors associated with the outcome examined here, i.e., pregnancy complications and poor birth outcomes. The present longitudinal study examined the moderating and mediating roles of certain risk factors on the relationships between depression and anxiety and pregnancy complications and poor birth outcomes. Potential predictors of antenatal depression and anxiety in this sample included ethnicity, single status, low level of education, low-income, poor physical activity,

smoking habit, stress, lack of social support, substance abuse, and alcohol consumption which eventually resulted in pregnancy complications and poor birth outcomes. Like our study, a large number of studies also highlighted these risk factors in developing maternal depression (Lancaster et al., 2010), which in turn contribute to obstetric complications and poor delivery outcomes such as preterm birth and low birth weight (Karaçam & Ançel, 2009). With the advantage of using the longitudinal study design, the present study explores the potential causal effect of these risk factors either as a mediator or as a moderator variable.

6.2 Mediation and moderation effects of risk factors

Despite the increasing number of literature suggesting associations between depression and anxiety during pregnancy and, pregnancy complications, and birth outcomes, little is known about the moderating or mediating effects of these risk factors. A possible mechanism for these associations could be better explained by causal pathway as well as interaction effect (Brittain et al., 2015) which was the main focus of our study.

6.2.1 Mediation effects of risk factors

Depression or anxiety disorder during pregnancy may increase the risk of pregnancy complications and perinatal outcomes such as preterm delivery or low birth weight directly or indirectly through one or more of the following mechanisms: (1) elevated psychological stress level, (2) lack of partner and family support, (3) poor satisfaction with the current relationship, (4) negative maternal coping behaviours, such as cigarette smoking, alcohol use, and illicit drugs use. These indirect links associated with depression or anxiety during pregnancy may work through causal pathways to result in adverse pregnancy complications and delivery outcomes. The present study explored seven candidate mediators measured in late pregnancy (30.6 ± 2.7 weeks), but only one mediator was identified as affecting the

relationship between depression and anxiety in early pregnancy and pregnancy complications.

In this study, presence of different types of stressors reported in late pregnancy mediated the relationship between depression and anxiety in early pregnancy, and major pregnancy complications. For depression, the presence of stressors in late pregnancy partially mediated the relationship between depression in early pregnancy and pregnancy complications in early postpartum. Our results indicated that pregnant women who experienced depression in early pregnancy were more likely to report different types of stressors in their late pregnancy such as the health of the unborn baby, financial support, or relationship with the partner, housing or inadequacy of food, compared to women who reported not experiencing depression.

Hence, depressed women experienced more stress resulting two or more pregnancy complications compared with non-depressed women who reported fewer stressors. To our knowledge, there is limited evidence on the mediating effect of psychological stress or general stress on the relationship between maternal mental health and pregnancy complications. My study findings also suggested that general stress at late pregnancy (late pregnancy) fully mediate the relationship between anxiety at early pregnancy (early pregnancy) and pregnancy complications. In other words, mothers who were anxious in early pregnancy experienced more stresses in late pregnancy resulting more pregnancy complications. It is expected that women with higher anxiety or depression disorder tend to have lower social support, low self-esteem, and less optimism which eventually lead to them in experiencing multiple stressors and more challenges. Hence, more perceived stress across their pregnancy may result in more pregnancy complications. In this study, psychosocial factors such as stress were hypothesized to mediate the relationship between maternal mental illness and pregnancy complications which supports our findings. Another study by Rahman et al., 2014 indicated stress as a significant mediator which either partially or fully mediate

the relationship with depression in late pregnancy which was consistent with the current study in reporting stress as a strong mediator (Rahman et al., 2014). Moreover, our study results suggest that more specific intervention programs are needed for women experiencing depression or anxiety during their pregnancy. Proper counselling by health care professional will be helpful to identify the stresses and challenges that women are going through. Making awareness about social support sharing caring are also required which will make them comfortable to share their problem and seek help from others.

Although there is limited evidence on the mediating role of psychosocial factors, i.e. general stress on the relationship, on the relationship between depression or anxiety and pregnancy complications, many studies highlighted stress as a potential risk factor in developing depression which in turn result in more pregnancy complications and adverse neonatal outcomes (Dolatian et al., 2016; Lilliecreutz et al., 2016). A case-control study in Tehran suggested that depressed and anxious women were more prone to suffer stress during their pregnancy which appeared as a primary predictor in developing pre-eclampsia (Kharaghani et al., 2012). A small number of studies suggest a possible biological etiology of pregnancy complications and adverse birth outcomes due to maternal mental illness. One possible explanation might be depression during pregnancy promotes the release of stress hormones which leads to pregnancy complications and negative birth outcomes by decreasing uterine blood flow (Becker et al., 2016; Ding et al., 2014; Smith et al., 2015).

Other psychosocial factors such as satisfaction with the current relationship and the lack of social support were also examined in this study but they were found to have mediation effect on the link between maternal mental health and pregnancy complications or birth outcomes. A number of epidemiological data indicated social support and satisfactory relation with a partner as protective factors in mitigating the symptoms of depression or anxiety among

women during their pregnancy (Cheng et al., 2016; Waqas et al., 2015). In general, women with absence of social support during pregnancy were more likely to be pessimistic and suffering from low self-esteem or self-worth, loss, and guilt (Kang et al., 2016). Additionally, satisfactory relationship with the current partner has a buffering effect in reducing depression or anxiety among mothers. Evidence also suggests that women who reported a poor relationship with their baby's father were at higher risk of developing depression and engaging in risky behaviours such as smoking (S. L. Martin et al., 2001). Overall it is well documented that strong social and family support has positive effects on maternal and fetal well-being through the promotion of a healthy lifestyle, and reduction of maternal mental illness either through direct or indirect pathways. A recent study reported both lacks of social support and poor satisfaction with the relationship as potential mediators for depression status at late pregnancy (Rahman et al., 2014). We expected that satisfaction with the current relationship and available social support or support from family act as major stimuli among women during their pregnancy which contributes to the well-being of the mother and the child. Nevertheless, the true underlying mechanism of satisfactory relationship and social support as mediators remain unclear for the maternal well-being during pregnancy and birth outcomes.

In mediation analysis, different types of risky behaviours such as tobacco and alcohol and recreational drug use reported in late pregnancy were also examined in the present study. While many literatures considered smoking, drinking alcohol or using drugs as independent risk factors for depression or pregnancy outcomes (Hanna et al., 1994; Holden et al., 2012; Lancaster et al., 2010; Pajulo et al., 2001), few studies have explored the underlying process of these risk factors on the linkage between maternal mental illness and pregnancy outcomes. Thus the present study explored the mechanism of an underlying temporal sequence of these risk factors on this linkage. Contrary to our expectation, this study did not find any mediation

effects of these risky behaviours for pregnancy complications or poor birth outcomes. It is plausible, however, that engaging in risky behaviours during pregnancy have significant mediating effects on the relationship between depression and pregnancy complications and poor birth outcomes. For example, Rahman et al., 2014 showed significant mediation effects of smoking and use of recreational drugs on the relationships between sociodemographic factors (i.e. maternal age, education, and marital status) and depression status at late pregnancy. Although the exact causal linkages linking smoking or substance abuse with maternal mental health is still unresolved, the authors reported that single mothers and who were younger in age and had low-level of education were more inclined to use drugs or smoke which precede depression status at late pregnancy (Rahman et al., 2014). It is also reported that women with mental illness are more likely to engage in risky behaviours such as smoking, alcohol consumption, and substance abuse (Bowen et al., 2009). In other words, smoking, alcohol consumption, and using drugs during pregnancy are likely used as coping strategies to reduce stress or mental illness such as depression, anxiety. Moreover, both smoking and drinking alcohol have a synergistic effect on adverse perinatal outcomes such as low birth weight, preterm birth etc. (Širvinskienė et al., 2016). Evidence also suggest that using recreational drugs along with other risky behaviours during pregnancy have detrimental effects on mother and child health. Hence, these factors are considered as strong risk factors in developing depression among mothers during pregnancy which lead to obstetric and neonatal complications; but none of these studies report mediating relationship of these risk behaviours between maternal mental health and pregnancy and birth outcomes. Clearly these are complex relationships and future studies are needed that are able to tease apart these complexities.

The current study also analyzed mediation effect of physical activity reported in late pregnancy on the relationship between maternal mental health and pregnancy complications.

Surprisingly, our study did not find physical activity as a mediator on this linkage. It is possible that the women who reported depression in early pregnancy were more likely to feel physical discomfort in late pregnancy and less likely to be physically active. However, findings from other studies suggest physical exercise as a potential mediator in reducing depressive symptoms though results are not consistent (Bowen et al., 2009; Rahman et al., 2014). It is reported that pregnant women are less likely to engage themselves in recommended physical activity than non-pregnant women. Additionally, depression during pregnancy may adversely impact positive health behaviours among women including poor physical activity (Demissie et al., 2013; Morrison, McCook, & Bailey, 2016). While research actively focusses on the beneficial role of physical activity in reducing pregnancy complications among mothers (Gaston & Vamos, 2013; Leppänen et al., 2014), extant findings limit the causal directionality of this relationship where exercise act as a mediator. Several studies identified physical exercise as a protective factor for elevating maternal mood and maternal health, therefore benefiting the developing fetus (Leppänen et al., 2014; Tendais et al., 2011); none of these studies examined the mediating relationships of depression and pregnancy complications where physical activity act as a mediator.

Contrary to our expectation, we did not find any mediating effects of these risk factors (i.e. lack of social support, satisfactory relationship, engaging in risky behaviours or exercise) on the relationship between depression or anxiety, and pregnancy complications and adverse neonatal outcomes. However, it is difficult to explain the causality as well as the temporal sequence of the underlying mechanism of these risk factors on this association. Thus, more research is needed to find out the mediating role of these potential risk factors to better understand this relationship for the well-being of the mother and fetus. Healthcare professionals should give attention to depression among women during their pregnancy and

proper intervention strategies for the targeted groups need to be initiated through routine follow-ups.

6.2.2 Moderation effects of risk factors

The present study analysed socio-demographic factors and any form of abuse reported in early pregnancy as moderator variables for pregnancy complications in early postpartum. As research on IPV has typically focused on IPV more broadly (i.e., general psychological, physical abuse, sexual abuse, and emotional abuse), the current study explored moderating effects of different types of abuse such as physical, sexual or emotional experienced just during pregnancy. Although a number of studies have suggested that abuse (of any type) during pregnancy is one of the major risk factors in developing adverse pregnancy complications (Alhusen, Lucea, Bullock, & Sharps, 2013) and neonatal outcomes (Alhusen et al., 2015), studies reporting a moderating role of abuse during pregnancy are limited. Most studies focus on either the risk factors associated with abuse or examining the prevalence and consequence of abuse during pregnancy. However, our findings suggest that sexual abuse significantly moderated the relationship between maternal mental health and pregnancy complications in both the early and late pregnancy. We found that depressed mothers who reported sexual abuse during or before their pregnancy were at increased risk of experiencing more than two pregnancy complications. Hence, sexual abuse has a negative effect on the relationship between depression or anxiety and major pregnancy complications such as gestational diabetes, hypertension, etc. during pregnancy. Although little is known about the moderating effects of abuse for pregnancy complications, it is well documented that abuse during pregnancy confers considerable risk to the health of the woman and her unborn child (Alhusen et al., 2013; Muhajarine & D'Arcy, 1999; Sharps et al., 2007). Research also indicate that abuse during pregnancy is associated with a number of pregnancy complications

including vaginal bleeding and abruption placenta (Daoud et al., 2012; Leone et al., 2010; Muhajarine & D'Arcy, 1999). Furthermore, preterm labour, low birth weight, and preterm delivery are common consequences of abuse among mothers (Alhusen et al., 2015; Hill et al., 2016). Many studies also revealed that women who did not report abuses compared with women who did were more likely to be in young age, had lower level of education, poor marital relationships, had low social support which in turn lead to more depression at the time of pregnancy (Alhusen et al., 2015; Stewart & Cecutti, 1993) which in turn cause pregnancy complications. Therefore, findings from the current study have implications for both prevention and intervention strategies used by healthcare professionals. First, screening for abuse in the health care setting is important to identify women at risk of or experiencing abuse. Then, to reduce violence and improve maternal and child outcomes, appropriate interventions need to be introduced to the women across their pregnancy.

The present study also examined the moderating effect of emotional abuse reported in early pregnancy for poor birth outcomes such as preterm delivery and low birth weight. We found that emotional abuse has a significant impact on the relationship between maternal mental health and adverse birth outcomes. Our findings suggest that emotional abuse experienced either by family members or by the perpetrator exacerbate the relationship between depression and preterm birth. It is likely that women who reported emotional abuse in early pregnancy tend to be more depressed in late pregnancy which consequently affects the poor neonatal outcomes such as preterm birth. It is possible that experiencing emotional abuse in early pregnancy heightens the risk of anxiety among women during the late pregnancy which then results in poor birth outcomes i.e. low birth. Nevertheless, the findings must be interpreted with caution. Abuse during pregnancy is a complex variable which is also considered a potential predictor in developing depression among women (Alhusen et al., 2015), which may lead to pregnancy complications and negative birth outcomes. More

research is needed to examine the causal pathways between abuses and poor pregnancy outcomes. A better understanding of the moderating and mediating effects might lead to medical and social interventions to improve outcomes.

We also found that single or non-partnered women who had anxiety in early pregnancy reported more pregnancy complications than partnered women. It is likely that women who are either married or have common law partner, experience less stress or anxiety during pregnancy due to partners' support which decreases the risk of pregnancy complications. Thus, the present study showed a positive moderating effect of marital status on the relationship between anxiety and pregnancy complications. Another study also found moderating role of marital status (i.e. buffering effect) on the relationship between depression and using recreational drugs (Rahman et al., 2014). Additionally, single or unmarried status of women is considered as a risk factor in developing depression during or after pregnancy along with other factors including low socioeconomic status and poor social support.

Young mothers who reported anxiety in their late pregnancy were at higher risk of experiencing multiple pregnancy complications. Our study found the significant moderating effect of age of the mother on the relationship between anxiety and major pregnancy complications. Younger women may feel more fear or anxiety about the unborn child and have poor social support during their pregnancy, resulting in more psychological stress or anxiety than older women. Though there is generally little evidence on the moderating role of maternal age, Rahman et al., 2014 also showed moderating effect of maternal age for depression symptoms in late pregnancy (Rahman et al., 2014). On the other hand, younger age of the mother is also reported as an independent risk factor for anxiety disorder (Dunkel Schetter et al., 2016).

Surprisingly, our study found ethnicity of the mother significantly moderated the relationship between depression and low birth weight. This study reported Aboriginal mothers who reported depression in late pregnancy were more likely to deliver low birth weight baby than non-aboriginal mothers. It is also reported that Aboriginal status along with poor partner relationship and lack of social support increase the risk of developing depression (Rahman et al., 2014). Depressive symptoms are higher among marginalized groups of people such as Aboriginal, immigrants, other minority women who have low resources and poor social support placing mother and fetal health in jeopardy (Miszkurka, Goulet, & Zunzunegui, 2010; Shah et al., 2011). It is likely that Aboriginal women in the society experience a number of challenges in their everyday lives than non-aboriginal women.

6.3 Strengths, limitations, and recommendations

6.3.1 Strengths

There are several strengths in the current study. First, the current study used the data from the project of feelings in pregnancy and motherhood study which was carried out in a longitudinal context. Hence, the prospective and longitudinal nature of this study help us to explore the changes in health status during two trimesters and after pregnancy in the same population of women. Thus, the results were reliable to find out significant associations between depression and anxiety and pregnancy complications and poor birth outcomes over/at different time points. Secondly, EPDS scale was used to measure the prevalence of depression and anxiety during pregnancy which has high sensitivity and specificity. Thus, our findings should have considerable reliability. We have analysed moderating and mediating role of certain risk factors resulting pregnancy and neonatal complications related to maternal mental health. The longitudinal nature of the data allowed us to examine the underlying mechanism with temporal precedence or in a causal pathway. Finally, the present

study used logistic regression for analysing moderating and mediating effects of the risk factors. The advantage of using this statistical method is its robustness, flexibility, easy and meaningful interpretation.

6.3.2 Limitations

There are also some limitations to the present study. The study comprised of self-reported data; there is a chance of recall bias reporting the pregnancy and labour complications. Also, EPDS scale was used to screen the depression and anxiety during pregnancy. Hence, the findings can not be generalized with clinical diagnosis criteria to the women having major depressive disorder. Although our study sample size was relatively large, most of the participants were well-educated and belong to high-income level. Hence, the present study only examined the presence of moderating and mediating effects of certain risk factors on the relationship between maternal mental health and poor pregnancy and negative birth outcomes. Therefore, reverse causality of mediating variable may also present which was not considered in our study. The current study did not test the significance of mediating variable effects i.e. difference between total and direct effect. Thus, significance test of moderation and mediation effects were not studied.

6.3.3 Conclusion and future implications

In response to these limitations, we make several suggestions for future research. Although our findings may not be generalizable to other population in different geographic and socioeconomic settings, the present study adds to the empirical literature by reporting the moderating and mediating effects of risk factors. By understanding the underlying mechanism of these risk factors for pregnancy and birth outcomes, clinicians may be better able to comprehensively weigh the risks and benefits of treatment interventions. These issues suggest that more research is warranted to explore the moderating and mediating effects of risk factors associated with prenatal depression among mothers which eventually leads to adverse health outcomes for the mother and child. Understanding the current research may provide health care professionals and clinicians with greater insight for early recognition and intervention of this issue. The findings of this project support the premise of early intervention to targeted women suffering from mental illness who are at high risk of developing depression. Targeting specific groups who are at high risk during their pregnancy is considered a relatively simple way of improving identification, intervention and prevention which in turn will have a positive impact on mother-infant bonding, and maternal and infant outcomes. Overall this study provides a clearer idea about the moderation and mediation effects of antecedent risk factors for pregnancy and birth outcomes which are useful in prevention and intervention programs as well as implications for future research.

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Appendix A: Ethical Approval



UNIVERSITY OF
SASKATCHEWAN

Behavioural Research Ethics Board (Beh-REB)

Certificate of Re-Approval

PRINCIPAL INVESTIGATOR	DEPARTMENT	Beh #
Angela Bowen	Nursing	04-183

INSTITUTION (S) WHERE RESEARCH WILL BE CARRIED OUT

University of Saskatchewan
Saskatoon SK

SUB-INVESTIGATOR(S)

Nazoem Muhajarine

FUNDER(S)

CANADIAN INSTITUTES OF HEALTH RESEARCH
(CIHR)

SASKATCHEWAN HEALTH RESEARCH
FOUNDATION (SHRF)

TITLE:

Antenatal and Early Postnatal Depression: Prevalence and Correlates in a Sample of High-Risk Women in Saskatoon

RE-APPROVED ON

21-Mar-2016

EXPIRY DATE

20-Mar-2017

Full Board Meeting

Delegated Review

CERTIFICATION

The University of Saskatchewan Behavioural Research Ethics Board has reviewed the above-named research project. The proposal was found to be acceptable on ethical grounds. The principal investigator has the responsibility for any other administrative or regulatory approvals that may pertain to this research project, and for ensuring that the authorized research is carried out according to the conditions outlined in the original protocol submitted for ethics review. This Certificate of Approval is valid for the above time period provided there is no change in experimental protocol or consent process or documents.

Any significant changes to your proposed method, or your consent and recruitment procedures should be reported to the Chair for Research Ethics Board consideration in advance of its implementation.

ONGOING REVIEW REQUIREMENTS

In order to receive annual renewal, a status report must be submitted to the REB Chair for Board consideration within one month of the current expiry date each year the study remains open, and upon study completion. Please refer to the following website for further instructions: http://www.usask.ca/research/ethics_review/

Vivian Ramsden, Chair
University of Saskatchewan
Behavioural Research Ethics Board

Please send all correspondence to:

Research Ethics Office
University of Saskatchewan
Box 5000 RPO University, 1607 - 110 Gymnasium Place
Saskatoon, SK S7N 4J8
Phone: (306) 966-2975 Fax: (306) 966-2069

Appendix B: FIP Questionnaires



***Feelings in Pregnancy and
Motherhood Study***

Intake, Early Pregnancy

_____

Department of Community Health and Epidemiology
University of Saskatchewan, Saskatoon, SK S7N 0W8
966-2093





Feelings in Pregnancy and Motherhood Study—Intake # _____

Interviewer

PRESENT PREGNANCY

How would you rate your overall health today? Excellent Very Good Good Fair Poor

Date of first pregnancy check-up _____ Who did you see? Doctor _____

What birth control did you use? none condom BCP Mirena/IUD Depoprovera
other _____

Did you plan this pregnancy? Yes No sort of

Do you plan to keep the baby? Yes No unsure

How do you feel about the pregnancy? happy scared overwhelmed not happy other _____

How does your family feel about the pregnancy? happy unsure overwhelmed not happy __

In the two weeks:

Have you felt down, depressed or hopeless?

not at all several days more than ½ the days nearly every day

Have you felt little interest or pleasure in doing things?

not at all several days more than ½ the days nearly every day

Do you plan to breastfeed? Yes No Undecided

Are you interested in Prenatal Classes? Yes No Undecided

CURRENT PREGNANCY—please check those that apply			
<input type="checkbox"/> severe nausea/vomiting	<input type="checkbox"/> incompetent cervix	<input type="checkbox"/> anemia	
<input type="checkbox"/> spotting/bleeding	<input type="checkbox"/> premature labour	<input type="checkbox"/> Rh factor	
<input type="checkbox"/> cramps	<input type="checkbox"/> Hypertension (high blood pressure)/swelling	<input type="checkbox"/> Diabetes	
<input type="checkbox"/> headaches	<input type="checkbox"/> Urinary Tract Infection	<input type="checkbox"/> dental problems	
<input type="checkbox"/> multiple pregnancy	<input type="checkbox"/> vaginal infection	<input type="checkbox"/> other	
<input type="checkbox"/> placenta previa	<input type="checkbox"/> StrepB infection		
Medication	Reason	Amount	Frequency

MARITAL STATUS Are you? single CL married divorced/separated widowed

CURRENT RELATIONSHIP WITH BABY’S FATHER? Yes No

HOW SATISFIED ARE YOU WITH THE RELATIONSHIP? very somewhat not satisfied

EDUCATION: What grade did you finish? Grade 8 or less Grade 9 – 11 Grade 12 Some post-secondary Post-secondary Some University University

ETHNIC BACKGROUND

Are you? Caucasian Treaty –Status Non-Status Métis Other



Feelings in Pregnancy and Motherhood Study—Intake # _____

Interviewer

PAST BIRTHS/ PREGNANCIES: G _____ P _____ T _____ P _____ A _____ L _____

NAME	DOB	M F	Birth Wt	Gest	Complications/Comments	Anomalies or problems with child	Breastfed	Lives with

G=all pregnancies; **P**=20 weeks on; **T**=Term; **P**=Preterm <37weeks; **A**=miscarriage<20wks/abortions; **L**=living

HEALTH HISTORY-check which things you have experienced problems with

<input type="checkbox"/> severe nausea/vomiting	<input type="checkbox"/> HIV	<input type="checkbox"/> thyroid
<input type="checkbox"/> spotting/bleeding	<input type="checkbox"/> Strep B Infection	<input type="checkbox"/> heart disease
<input type="checkbox"/> headaches	<input type="checkbox"/> anemia	<input type="checkbox"/> allergies
<input type="checkbox"/> Urinary Tract Infection	<input type="checkbox"/> Rh factor	<input type="checkbox"/> surgeries
<input type="checkbox"/> vaginal infection	<input type="checkbox"/> diabetes	<input type="checkbox"/> other
<input type="checkbox"/> Sexually Transmitted Infections	<input type="checkbox"/> seizures	<input type="checkbox"/> other
<input type="checkbox"/> Hepatitis		

HOUSING Do you? own rent parents room & board YWCA other
of adults in household _____ # of children under 18 _____

Is it Adequate/suitable? yes no unknown Plan to move: yes no when? _____

EMPLOYMENT Do you work outside the home? Yes No
If yes, What is your occupation? _____ how many hours/week do you work? _____

FINANCES Do you have any financial concerns: Yes No
Are you getting? DCRE/social services Employment Supplement Band funding Student loan PTA
 parents partner _____

In the past 12 months, did you or anyone else in your house.
Not have enough food to eat? Yes No
Worry that there would not be enough to eat because of a lack of money? Yes No

Do you have a history of PMS? Yes No When did it start? _____ age before or after pregnancies
Treated Yes No Medication Yes No

Do you have a history of depression? Yes No when?
Treated Yes No Medication Yes No



Feelings in Pregnancy and Motherhood Study—Intake # _____

Interviewer

Did you have depression in previous pregnancy? Yes No when?
Treated Yes No Medication Yes No

Have you had postpartum depression? Yes No when?
Treated Yes No Medication Yes No

Do your moods go up and down? not at all several days more than 1/2 the days nearly every day

Do you have mood swings that occur for no reason? not at all several days more than 1/2 the days nearly every day

Now some questions about your family...

Is your mother alive? Yes No If no, how old were you when she died? _____

Did your mother or any of your sisters have depression before or after giving birth? unknown
Mother Yes No sister: 1 Yes No 2. Yes No 3. Yes No

What things are causing you the most stress right now? nothing right now *if yes what?*
 being pregnant partner/relationship not enough money children family
 where I live health of my baby birth of my baby health work
 school Other _____

Do you have someone to turn to for emotional support? Yes No *If yes, who gives you support?*
 Partner Mother (*don't ask if mother not alive*) Friend Female relatives Other _____

Who of these gives you the most support? _____
Can you count on that person to care about you no matter what? Yes No

During the past year, from yesterday to one year ago yesterday...
Have you had a drink alcoholic beverages (beer, wine, coolers) at all? Yes No *If yes,*

Did you drink alcohol?
Less than once a month once a month 2 to 3 times/month
once a week 2 to 3 times a week 4-6 times a week every day

How often did you have more than 5 drinks at one time?
Never less than once a month once a month
2 to 3 times/month once a week more than once a week

During the past week, did you drink alcohol? Yes No

The next three questions relate to any type of abuse you may be experiencing.
Has anyone ever hit, slap, restrained, punch, pinch, kick, beat you? Yes No
Has anyone ever yell, belittle, berate, blame, neglect? Yes No
Has anyone touched you against your will, raped you? Yes No

Have you had counseling in the past? Yes No
If yes, what for? depression relationship addiction eating disorder abuse
 other _____

Are you seeing a counselor right now? Yes No
If yes, why? depression relationship addiction eating disorder abuse

Do you have any legal problems? Yes No

Date: _____ Interviewer: _____ person/telephone



Please underline the answer, which comes closest to how you have felt in the past 7 days, not just how you feel today:

I have felt happy:

- Yes, most of the time
- Yes, some of the time
- No, not very often
- No, not at all

In the past 7 days:

1. I have been able to laugh and see the funny side of things:
 - As much as I always could
 - Not quite so much now
 - Definitely not so much now
 - Not at all
2. I have looked forward with enjoyment to things:
 - As much as I ever did
 - Rather less than I used to
 - Definitely less than I used to
 - Hardly at all
3. I have blamed myself unnecessarily when things went wrong:
 - Yes, most of the time
 - Yes, some of the time
 - Not very often
 - No, never
4. I have been anxious or worried for no good reason:
 - No, not at all
 - Hardly ever
 - Yes, sometimes
 - Yes, very often
5. I have felt scared or panicky for no very good reason:
 - Yes, quite a lot
 - Yes, sometimes
 - No, not much
 - No, not at all
6. Things have been getting on top of me:
 - Yes, most of the time I haven't been able to cope at all
 - Yes, sometimes I haven't been coping as well as usual
 - No, most of the time I have coped quite well
 - No, I have been coping as well as ever
7. I have been so unhappy that I have had difficulty sleeping:
 - Yes, most of the time
 - Yes, sometimes
 - Not very often
 - No, not at all
8. I have felt sad or miserable:
 - Yes, most of the time
 - Yes, quite often
 - Not very often
 - No, not at all
9. I have been so unhappy that I have been crying:
 - Yes, most of the time
 - Yes, quite often
 - Only occasionally
 - No, never
10. The thought of harming myself has occurred to me:
 - Yes, quite often
 - Sometimes
 - Hardly ever
 - Never



Circle the response that fits closest to your experience during the past 7 days.

1. How often have you felt like being sick (nauseated) in the past week?

All the time More than once a day Daily 3-6 days during the week Occasionally Not at all

2. How often have you retched/dry heaved (but without actually being sick) in the past week?

All the time More than once a day Daily 3-6 days during the week Occasionally Not at all

3. How often have you been physically sick (vomited) during the past week?

All the time More than once a day Daily 3-6 days during the week Occasionally Not at all

Please circle a number for each one to show how much of a worry it is to you now, from 1 if it is not a worry to 5 if it is something that you are extremely worried about:

	Not a worry			Major worry	
	1	2	3	4	5
Your housing	1	2	3	4	5
Money problems	1	2	3	4	5
Problems with the law	1	2	3	4	5
Your relationship with your partner/husband	1	2	3	4	5
Your relationship with your family and friends	1	2	3	4	5
Your own health	1	2	3	4	5
The health of someone close to you	1	2	3	4	5
Employment problems	1	2	3	4	5
The possibility of something being wrong with baby	1	2	3	4	5
Going to hospital	1	2	3	4	5
Internal examinations	1	2	3	4	5
Giving birth	1	2	3	4	5
Coping with the new baby	1	2	3	4	5
Giving up work (if applicable)	1	2	3	4	5
Whether your partner will be with you for the birth	1	2	3	4	5
Possibility of miscarriage	1	2	3	4	5

If there is anything else that is worrying you or you would like to say anything more about any of the above, please use this space to tell us about it:

How many drinks can you hold? _____

Have close friends or relatives worried or complained about your drinking in the last year? Yes No

Do you sometimes take a drink in the morning when you first get up? Yes No

Has a friend or family member ever told you about things you said or did while you were drinking that you could not remember?? Yes No

Do you sometimes feel the need to cut down on your drinking? Yes No



In the last month...

How much do you exercise? (walking for 20 minutes, swimming etc.)

- Every day
- 2-3 times a week
- Occasionally
- Never

How much do you smoke? (✓ one)

- More than a pack/day
- 5-20/day
- Less than 5 a day
- Quit since pregnant
- Quit before pregnant
- I never smoked

Does anyone else smoke inside your home? Yes No

How often did you drink beer or other alcohol? (✓ all that apply)

- Occasional drink or 2
- 1-2 drinks a day
- 5+ drinks at one time
- Quit since pregnant
- Quit before pregnant
- I never drank alcohol

How often did you use drugs such as marijuana, crystal meth. cocaine? (✓ one)

- Regular (every day)
- Occasionally
- Quit since pregnancy
- Quit before pregnant
- I never use such drugs

Your family income: (✓ one only)

- Social/Band Assistance:
- Less than \$20,000./yr
- \$20-40,000./yr
- \$40-60,000./yr
- More than \$60,000./yr



I have frequent hiccups. (Place an 'X' on the line as below)



In the last month how much have the following statements been true for you?

1. I have frequent ups and downs of moods.



2. I have mood swings that occur for no reason.



3. Other people complain about my mood swings.



4. Because of my moods, I have trouble following through with my plans.



5. I don't like to make commitments because my moods might change.



Your postal code _____

Please circle the number to indicate whether you strongly agree, agree, disagree or strongly disagree to the following statements about your community	Strongly Disagree 1	Disagree 2	Agree 3	Strongly Agree 4
This is a close knit neighbourhood	1	2	3	4
People in this neighbourhood can be trusted	1	2	3	4
People around here are willing to help their neighbours	1	2	3	4
People in this neighbourhood do not share the same values	1	2	3	4
People in this neighbourhood generally do not get along with each other	1	2	3	4
It is safe to walk alone in this neighbourhood after dark	1	2	3	4
It is safe for children to play outside during the day	1	2	3	4
There are good parks, playgrounds and play spaces in this neighbourhood	1	2	3	4

How do you feel about your neighbourhood as a place to bring up child? Is it...

Excellent Good Average Poor Very poor



Feelings in Pregnancy and Motherhood Study—Intake # _____

Interviewer _____

1. I have been able to laugh and see the funny side of things:
 - As much as I always could **0**
 - Not quite so much now **1**
 - Definitely not so much now **2**
 - Not at all **3**

 2. I have looked forward with enjoyment to things:
 - As much as I ever did **0**
 - Rather less than I used to **1**
 - Definitely less than I used to **2**
 - Hardly at all **3**

 3. I have blamed myself unnecessarily when things went wrong:
 - Yes, most of the time **3**
 - Yes, some of the time **2**
 - Not very often **1**
 - No, never **0**

 4. I have been anxious or worried for no good reason:
 - No, not at all **0**
 - Hardly ever **1**
 - Yes, sometimes **2**
 - Yes, very often **3**

 5. I have felt scared or panicky for no very good reason:
 - Yes, quite a lot **3**
 - Yes, sometimes **2**
 - No, not much **1**
 - No, not at all **0**

 6. Things have been getting on top of me:
 - Yes, most of the time I haven't been able to cope at all **3**
 - Yes, sometimes I haven't been coping as well as usual **2**
 - No, most of the time I have coped quite well **1**
 - No, I have been coping as well as ever **0**

 7. I have been so unhappy that I have had difficulty sleeping:
 - Yes, most of the time **3**
 - Yes, sometimes **2**
 - Not very often **1**
 - No, not at all **0**

 8. I have felt sad or miserable:
 - Yes, most of the time **3**
 - Yes, quite often **2**
 - Not very often **1**
 - No, not at all **0**

 9. I have been so unhappy that I have been crying:
 - Yes, most of the time **3**
 - Yes, quite often **2**
 - Only occasionally **1**
 - No, never **0**

 10. The thought of harming myself has occurred to me:
 - Yes, quite often **3**
 - Sometimes **2**
 - Hardly ever **1**
 - Never **0**
- SCORE _____ Gestation _____ wks**

REFERRAL Refused reason _____

- Family Physician KidsFirst Community Clinic Crisis Emergency
Mental Health Services Counselor Other _____

Comments:

Interviewer Person/Telephone Date



Feelings in Pregnancy and Motherhood Study

Late Pregnancy

_____

Department of Community Health and Epidemiology
University of Saskatchewan, Saskatoon, SK S7N 0W8
966-2093





Please underline the answer, which comes closest to how you have felt in the past 7 days, not just how you feel today:

I have felt happy:

- Yes, most of the time
- Yes, some of the time
- No, not very often
- No, not at all

In the past 7 days:

1. I have been able to laugh and see the funny side of things:
 - As much as I always could
 - Not quite so much now
 - Definitely not so much now
 - Not at all

2. I have looked forward with enjoyment to things:
 - As much as I ever did
 - Rather less than I used to
 - Definitely less than I used to
 - Hardly at all

3. I have blamed myself unnecessarily when things went wrong:
 - Yes, most of the time
 - Yes, some of the time
 - Not very often
 - No, never

4. I have been anxious or worried for no good reason:
 - No, not at all
 - Hardly ever
 - Yes, sometimes
 - Yes, very often

5. I have felt scared or panicky for no very good reason:
 - Yes, quite a lot
 - Yes, sometimes
 - No, not much
 - No, not at all

6. Things have been getting on top of me:
 - Yes, most of the time I haven't been able to cope at all
 - Yes, sometimes I haven't been coping as well as usual
 - No, most of the time I have coped quite well
 - No, I have been coping as well as ever

7. I have been so unhappy that I have had difficulty sleeping:
 - Yes, most of the time
 - Yes, sometimes
 - Not very often
 - No, not at all

8. I have felt sad or miserable:
 - Yes, most of the time
 - Yes, quite often
 - Not very often
 - No, not at all

9. I have been so unhappy that I have been crying:
 - Yes, most of the time
 - Yes, quite often
 - Only occasionally
 - No, never

10. The thought of harming myself has occurred to me:
 - Yes, quite often
 - Sometimes
 - Hardly ever
 - Never



Since we last met...have you been prescribed or taken medications? Yes No

Or taken any over the counter medications? Yes No

WHEN	How many weeks pregnant?	WHAT medication	WHAT FOR

Are you taking any medications now? Yes No
 if yes, What? _____ Why? _____

Since we last met..

Have you had a drink alcoholic beverages (beer, wine, coolers) at all? Yes No *if yes,*

Did you drink alcohol?

Less than once a month once a month 2 to 3 times/month
 once a week 2 to 3 times a week 4-6 times a week every day

how often did you have more than 5 drinks at one time?

Never less than once a month once a month
 2 to 3 times/month once a week more than once a week

During the past week, did you drink alcohol? Yes No

Please circle a number for each one to show how much of a worry it is to you now, from 1 if it is not a worry to 5 if it is something that you are extremely worried about:

	Not a worry			Major worry	
	1	2	3	4	5
Your housing	1	2	3	4	5
Money problems	1	2	3	4	5
Problems with the law	1	2	3	4	5
Your relationship with your partner/husband	1	2	3	4	5
Your relationship with your family and friends	1	2	3	4	5
Your own health	1	2	3	4	5
The health of someone close to you	1	2	3	4	5
Employment problems	1	2	3	4	5
The possibility of something being wrong with baby	1	2	3	4	5
Going to hospital	1	2	3	4	5
Internal examinations	1	2	3	4	5
Giving birth	1	2	3	4	5
Coping with the new baby	1	2	3	4	5
Giving up work (if applicable)	1	2	3	4	5
Whether your partner will be with you for the birth	1	2	3	4	5
Labour too early	1	2	3	4	5

If there is anything else that is worrying you or you would like to say anything more about any of the above, please use this space to tell us about it:



I have frequent hiccups. (Place an 'X' on the line as below)

Not at all true
X
 Yes, very much true

In the last month how much have the following statements been true for you?

1. I have frequent ups and downs of moods.

Not at all true
|
 Yes, very much true

2. I have mood swings that occur for no reason.

Not at all true
|
 Yes, very much true

3. Other people complain about my mood swings.

Not at all true
|
 Yes, very much true

4. Because of my moods, I have trouble following through with my plans.

Not at all true
|
 Yes, very much true

5. I don't like to make commitments because my moods might change.

Not at all true
|
 Yes, very much true

Circle the response that fits closest to your experience during the past 7 days.

1. How often have you felt like being sick (nauseated) in the past week?

All the time More than once a day Daily 3-6 days during the week Occasionally Not at all

2. How often have you retched/dry heaved (but without actually being sick) in the past week?

All the time More than once a day Daily 3-6 days during the week Occasionally Not at all

3. How often have you been physically sick (vomited) during the past week?

All the time More than once a day Daily 3-6 days during the week Occasionally Not at all

Please circle the number to indicate whether you strongly agree, agree, disagree or strongly disagree to the following statements about your community

	Strongly Disagree 1	Disagree 2	Agree 3	Strongly Agree 4
This is a close knit neighbourhood	1	2	3	4
People in this neighbourhood can be trusted	1	2	3	4
People around here are willing to help their neighbours	1	2	3	4
People in this neighbourhood do not share the same values	1	2	3	4
People in this neighbourhood generally do not get along with each other	1	2	3	4
It is safe to walk alone in this neighbourhood after dark	1	2	3	4
It is safe for children to play outside during the day	1	2	3	4
There are good parks, playgrounds and play spaces in this neighbourhood	1	2	3	4

How do you feel about your neighbourhood as a place to bring up child? Is it...
Excellent Good Average Poor Very poor

postal code _____



How would you rate your overall health today? Excellent Very Good Good Fair Poor

What things are causing you the most stress right now? nothing right now
 being pregnant partner/relationship not enough money children family
 where I live health of my baby birth of my baby health work
 school Other _____

Do you have someone to turn to for emotional support? Yes No
if yes, who gives you support? Partner Mother Friend _____ Female relatives
Other who? _____
Who of these gives you the most support? _____

Can you count on that person to care about you no matter what? Yes No

In the two weeks:

Have you felt down, depressed or hopeless?
 not at all several days more than ½ the days nearly every day

Have you felt little interest or pleasure in doing things?
 not at all several days more than ½ the days nearly every day

Are you in a relationship now? Yes No
If yes, How satisfied are you with the relationship? very somewhat not satisfied

Since we last talked to you...
Have you been hit, kicked, pushed, pinched, restrained or otherwise physically hurt? Yes No

Are you seeing a counsellor right now? Yes No
If yes, for what? Depression Stress Relationship Alcohol
Other please specify _____

In the last month...

How much do you exercise? (walking for 20 minutes, swimming etc.)
Every day
2-3 times a week
Occasionally
Never

How much do you smoke? (one)
More than a pack/day
5-20/day
Less than 5 a day
Quit since pregnant
Quit before pregnant
I never smoked

Does anyone else smoke inside your home? Yes No

How often did you drink beer or other alcohol? (ALL that apply)
Occasional drink or 2
1-2 drinks a day
5+ drinks at one time
Quit since pregnant
Quit before pregnant
I never drank alcohol

How often did you use drugs such as marijuana, crystal meth. cocaine? (one)
Regular (every day)
Occasionally
Quit since pregnancy
Quit before pregnant
I never use such drugs



Interviewer _____

- 1. I have been able to laugh and see the funny side of things:
 - As much as I always could **0**
 - Not quite so much now **1**
 - Definitely not so much now **2**
 - Not at all **3**

 - 2. I have looked forward with enjoyment to things:
 - As much as I ever did **0**
 - Rather less than I used to **1**
 - Definitely less than I used to **2**
 - Hardly at all **3**

 - 3. I have blamed myself unnecessarily when things went wrong:
 - Yes, most of the time **3**
 - Yes, some of the time **2**
 - Not very often **1**
 - No, never **0**

 - 4. I have been anxious or worried for no good reason:
 - No, not at all **0**
 - Hardly ever **1**
 - Yes, sometimes **2**
 - Yes, very often **3**

 - 5. I have felt scared or panicky for no very good reason:
 - Yes, quite a lot **3**
 - Yes, sometimes **2**
 - No, not much **1**
 - No, not at all **0**

 - 6. Things have been getting on top of me:
 - Yes, most of the time I haven't been able to cope at all **3**
 - Yes, sometimes I haven't been coping as well as usual **2**
 - No, most of the time I have coped quite well **1**
 - No, I have been coping as well as ever **0**

 - 7. I have been so unhappy that I have had difficulty sleeping:
 - Yes, most of the time **3**
 - Yes, sometimes **2**
 - Not very often **1**
 - No, not at all **0**

 - 8. I have felt sad or miserable:
 - Yes, most of the time **3**
 - Yes, quite often **2**
 - Not very often **1**
 - No, not at all **0**

 - 9. I have been so unhappy that I have been crying:
 - Yes, most of the time **3**
 - Yes, quite often **2**
 - Only occasionally **1**
 - No, never **0**

 - 10. The thought of harming myself has occurred to me:
 - Yes, quite often **3**
 - Sometimes **2**
 - Hardly ever **1**
 - Never **0**
- SCORE** _____ **Gestation** _____ **wks**

REFERRAL Refused reason _____

- Family Physician
- KidsFirst
- Community Clinic
- Crisis
- Emergency
- Mental Health Services
- Counselor
- Other _____

Comments:

Interviewer _____ Person/Telephone _____ Date _____



Feelings in Pregnancy and Motherhood Study

**Postpartum
#_____**

Department of Community Health and Epidemiology
University of Saskatchewan, Saskatoon, SK S7N 0W8
966-2093





Interviewer

BABY: Date of Birth D ___/M ___/Y ___ Gestation at birth ___ weeks

Female Male Birth weight ___gr / ___lbs ___oz Length ___cm APGAR: 1 ___ 5 ___
Female Male Birth weight ___gr / ___lbs ___oz Length ___cm APGAR: 1 ___ 5 ___

BREASTFEEDING now Yes No both
if yes, has the baby had any food supplements other than expressed breastmilk? Yes No

PREGNANCY COMPLICATIONS No Yes (check all that apply)

- Urinary Tract Infection Sexually Transmitted Infection Vaginal Infection HIV Hepatitis
- StrepB Infection Rh Factor Antenatal Bleeding Placenta Previa
- Abruption Gestational Diabetes High Blood Pressure (Gestational Induced Hypertension)
- Anemia Swelling/Edema Incompetent Cervix Thyroid
- Headaches Severe Nausea/Vomiting
- Other _____

ONSET OF LABOUR spontaneous induced

TYPE OF DELIVERY spontaneous vaginal vacuum forceps c/section for: _____

ANESTHETIC None epidural spinal general local

LABOUR & DELIVERY COMPLICATIONS No Yes (check all that apply)

- Induction Premature Labour Pregnancy Induced Hypertension
- Premature Rupture of Membranes Abruption Postpartum hemorrhage
- Infection in mother other _____

NEONATAL COMPLICATIONS No yes (check all that apply)

- Strep B Meconium Infection in baby Jaundice Withdrawal Rh other

NICU for baby, why? _____ how long? __
comments

BIRTH DEFECTS None neural tube cleft lip/palate heart defect other

MATERNAL WEIGHT GAIN ___kg ___lb

Did you attend Prenatal Classes? Yes No
 Did you attend Breastfeeding Classes? Yes No

Since we last met...

have you been prescribed or taken medications? Or taken any over the counter medications?

WHEN	How many weeks pregnant or postpartum	WHAT medication	WHAT FOR
Are you taking any medications now? What?			Why?



Please underline the answer, which comes closest to how you have felt in the past 7 days, not just how you feel today:

I have felt happy:

Yes, most of the time

Yes, some of the time

No, not very often

No, not at all

In the past 7 days:

1. I have been able to laugh and see the funny side of things:
As much as I always could
Not quite so much now
Definitely not so much now
Not at all
2. I have looked forward with enjoyment to things:
As much as I ever did
Rather less than I used to
Definitely less than I used to
Hardly at all
3. I have blamed myself unnecessarily when things went wrong:
Yes, most of the time
Yes, some of the time
Not very often
No, never
4. I have been anxious or worried for no good reason:
No, not at all
Hardly ever
Yes, sometimes
Yes, very often
5. I have felt scared or panicky for no very good reason:
Yes, quite a lot
Yes, sometimes
No, not much
No, not at all
6. Things have been getting on top of me:
Yes, most of the time I haven't been able to cope at all
Yes, sometimes I haven't been coping as well as usual
No, most of the time I have coped quite well
No, I have been coping as well as ever
7. I have been so unhappy that I have had difficulty sleeping:
Yes, most of the time
Yes, sometimes
Not very often
No, not at all
8. I have felt sad or miserable:
Yes, most of the time
Yes, quite often
Not very often
No, not at all
9. I have been so unhappy that I have been crying:
Yes, most of the time
Yes, quite often
Only occasionally
No, never
10. The thought of harming myself has occurred to me:
Yes, quite often
Sometimes
Hardly ever
Never



Circle the response that fits closest to your experience during the past 7 days.

1. How often have you felt like being sick (nauseated) in the past week?

All the time More than once a day Daily 3-6 days during the week Occasionally Not at all

2. How often have you retched/dry heaved (but without actually being sick) in the past week?

All the time More than once a day Daily 3-6 days during the week Occasionally Not at all

3. How often have you been physically sick (vomited) during the past week?

All the time More than once a day Daily 3-6 days during the week Occasionally Not at all

Since we last met..

Have you had a drink alcoholic beverages (beer, wine, coolers) at all? Yes No **if yes,**

Since we last met, did you drink alcohol?

Less than once a month once a month 2 to 3 times/month
 once a week 2 to 3 times a week 4-6 times a week every day

Since we last met, how often did you have more than 5 drinks at one time?

Never 1 less than once a month once a month
 2 to 3 times/month once a week more than once a week

During the past week, did you drink alcohol? Yes No

Please circle a number for each one to show how much of a worry it is to you now, from 1 if it is not a worry to 5 if it is something that you are extremely worried about:

	Not a worry			Major worry	
	1	2	3	4	5
Your housing	1	2	3	4	5
Money problems	1	2	3	4	5
Problems with the law	1	2	3	4	5
Your relationship with your partner/husband	1	2	3	4	5
Your relationship with your family and friends	1	2	3	4	5
Your own health	1	2	3	4	5
The health of someone close to you	1	2	3	4	5
Employment problems	1	2	3	4	5
The possibility of something being wrong with baby	1	2	3	4	5
Coping with the new baby	1	2	3	4	5
Giving up work (if applicable)	1	2	3	4	5
Your housing	1	2	3	4	5
Money problems	1	2	3	4	5
Problems with the law	1	2	3	4	5

If there is anything else that is worrying you or you would like to say anything more about any of the above, **Please use this space to tell us about it:**



How would you rate your overall health today? Excellent Very Good Good Fair Poor

What things are causing you the most stress right now? nothing right now *if yes, what*

- partner/relationship not enough money children family
 where I live health of my baby birth of my baby health work
 school Other _____

In the two weeks:

Have you felt down, depressed or hopeless?

- not at all several days more than 1/2 the days nearly every day

Have you felt little interest or pleasure in doing things?

- not at all several days more than 1/2 the days nearly every day

Do you have someone to turn to for emotional support? Yes No

If yes, who gives you support? Partner Mother Friend _____ Female relatives

Other who? _____ Who of these gives you the most support? _____

Can you count on that person to care about you no matter what? Yes No

Are you in a relationship now? Yes No

If yes, How satisfied are you with the relationship? very somewhat not satisfied

Since we last met...

Have you been hit, kicked, pushed, pinched, restrained, or otherwise physically hurt, since becoming pregnant? Yes
No

Are you seeing a counsellor right now? Yes No

If yes, for what? Depression Stress Relationship Alcohol

Other please specify _____

In the last month...

How much do you exercise? (walking for 20 minutes, swimming etc.)

- Every day
 2-3 times a week
 Occasionally
 Never

How much do you smoke? (one)

- More than a pack/day
 5-20/day
 Less than 5 a day
 Quit since pregnant
 Quit before pregnant
 I never smoked

Does anyone else smoke inside your home? Yes No

How often did you drink beer or other alcohol? (ALL that apply)

- Occasional drink or 2
 1-2 drinks a day
 5+ drinks at one time
 Quit since pregnant
 Quit before pregnant
 I never drank alcohol

How often did you use drugs such as marijuana, crystal meth, cocaine? (one)

- Regular (every day)
 Occasionally
 Quit since pregnancy
 Quit before pregnant
 I never use such drugs



I have frequent hiccups. (Place an 'X' on the line as below)



In the last month how much have the following statements been true for you?

1. **I have frequent ups and downs of moods.**



2. **I have mood swings that occur for no reason.**



3. **Other people complain about my mood swings.**



4. **Because of my moods, I have trouble following through with my plans.**



5. **I don't like to make commitments because my moods might change.**



Your postal code _____

Please circle the number to indicate whether you strongly agree, agree, disagree or strongly disagree to the following statements about your community	Strongly Disagree 1	Disagree 2	Agree 3	Strongly Agree 4
This is a close knit neighbourhood	1	2	3	4
People in this neighbourhood can be trusted	1	2	3	4
People around here are willing to help their neighbours	1	2	3	4
People in this neighbourhood do not share the same values	1	2	3	4
People in this neighbourhood generally do not get along with each other	1	2	3	4
It is safe to walk alone in this neighbourhood after dark	1	2	3	4
It is safe for children to play outside during the day	1	2	3	4
There are good parks, playgrounds and play spaces in this neighbourhood	1	2	3	4

How do you feel about your neighbourhood as a place to bring up child? Is it...

Excellent Good Average Poor Very poor



Feelings in Pregnancy and Motherhood Study -- **POSTPARTUM**

Interviewer _____

- 1. I have been able to laugh and see the funny side of things:
 - As much as I always could **0**
 - Not quite so much now **1**
 - Definitely not so much now **2**
 - Not at all **3**
 - 2. I have looked forward with enjoyment to things:
 - As much as I ever did **0**
 - Rather less than I used to **1**
 - Definitely less than I used to **2**
 - Hardly at all **3**
 - 3. I have blamed myself unnecessarily when things went wrong:
 - Yes, most of the time **3**
 - Yes, some of the time **2**
 - Not very often **1**
 - No, never **0**
 - 4. I have been anxious or worried for no good reason:
 - No, not at all **0**
 - Hardly ever **1**
 - Yes, sometimes **2**
 - Yes, very often **3**
 - 5. I have felt scared or panicky for no very good reason:
 - Yes, quite a lot **3**
 - Yes, sometimes **2**
 - No, not much **1**
 - No, not at all **0**
 - 6. Things have been getting on top of me:
 - Yes, most of the time I haven't been able to cope at all **3**
 - Yes, sometimes I haven't been coping as well as usual **2**
 - No, most of the time I have coped quite well **1**
 - No, I have been coping as well as ever **0**
 - 7. I have been so unhappy that I have had difficulty sleeping:
 - Yes, most of the time **3**
 - Yes, sometimes **2**
 - Not very often **1**
 - No, not at all **0**
 - 8. I have felt sad or miserable:
 - Yes, most of the time **3**
 - Yes, quite often **2**
 - Not very often **1**
 - No, not at all **0**
 - 9. I have been so unhappy that I have been crying:
 - Yes, most of the time **3**
 - Yes, quite often **2**
 - Only occasionally **1**
 - No, never **0**
 - 10. The thought of harming myself has occurred to me:
 - Yes, quite often **3**
 - Sometimes **2**
 - Hardly ever **1**
 - Never **0**
- SCORE** _____ **pp** _____ **wks**

REFERRAL Refused reason _____
Family Physician KidsFirst Community Clinic Crisis Emergency
Mental Health Services Counselor Other _____

All three study Times complete yes no, if no, why not
Miscarriage Abortion Stillbirth Baby up for adoption
Moved refused Unable to reach Other

Comments _____

 Interviewer Person/Telephone Date