

Examining the Factors that Moderate and Mediate the Effects on Depression during Pregnancy and Postpartum

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Abstract

Background: This research report will address the knowledge gap in understanding the role of risk factors as moderators or mediators to explain the variability in the magnitude of exposure and the causal pathway for antenatal and postpartum depression.

Methods: Using Feelings in Pregnancy and Motherhood (FIP) longitudinal study, 649 pregnant women were interviewed three times during pregnancy and postpartum. Depression status (measured in EPDS) in late pregnancy and postpartum were two outcomes of interest. Socio-demographic predictors were considered as moderators, and behavioral and psychosocial variables were considered as mediators. Moderators and mediators were tested through series of regression analysis.

Results: In modeling moderating effects in late pregnancy, low income women who were in poor partner relationships ($\beta=1.54$; $p<0.05$) and partnered women who reported having used recreational drugs ($\beta= -1.62$; $p<0.05$) were more likely to be depressed. Young mothers with low social support ($\beta= 1.04$; $p=0.15$) and Aboriginal mothers with low social support ($\beta= 1.12$; $p=0.17$) were noted to have depressive symptoms in late pregnancy. In mediating analysis for late pregnancy, psychosocial mediators - stress, social support, and relationship satisfaction, and behavioral factors - smoking and recreational drug use exerted mediating effect for depressive symptoms. In moderating analysis for postpartum, Aboriginal women who had never exercised in late pregnancy were found to be depressed at postpartum. For mediating effects in postpartum, relationship satisfaction, stress, and smoking were significant.

Conclusion: The moderating and mediating role of the risk factors could be strategically used to provide tailored programs to women who experience depression during pregnancy and postpartum.

Keywords: Postpartum; Socio-demographic; Pregnancy; Aboriginal; Moderators

Introduction

Maternal depression encompasses a spectrum of depressive conditions that can affect expectant mothers and those up to twelve months postpartum [1]. Estimates of antenatal and postpartum depression in the general population range from 12 to 20% [2,3]. Antenatal depression is a relatively new area of study compared to postpartum depression and the depth and sophistication of this research is still developing. Studies have found that the prevalence of antenatal depression could be higher than postpartum depression [4]. We also noted higher prevalence of antenatal depression (14.1% in early pregnancy; 10.4% in late pregnancy) than postpartum depression (8.1%) [5].

Maternal depression has both immediate and longer-term consequences. Mothers with depression may have diminished capacity for self-care, as well as care for her infant [6]. They reported more sleep disturbances, and anxiety [7]. They were likely to have less frequent antenatal care [6], and reduced optimal fetal monitoring during pregnancy [8]. Antenatal depression was associated with preterm delivery [9], lower birth weight, and small for gestational age [10]. Studies have found maternal postpartum depression to hamper a child's cognitive, emotional, and social development in infancy and early childhood [11-13].

Given the high prevalence and serious consequences of antenatal and postpartum depression, a review of the empirical literature revealed a range of antecedent risk factors, but very little reported on the specific role of the risk factors, for example either as moderating or mediating role on depression. Studies examining mediating or moderating role

of the antecedent risk factors in relation to antenatal and postpartum depression is relatively rare in epidemiological research. A mediator is defined as an intermediate variable that accounts for the relationship between predictor and outcome variable [14]. Mediators attempt to describe 'why' and 'how' effects occur [14]. In behavioral research, psychosocial variables such as social support and self-efficacy are often hypothesized as mediating roles [15]. Moderator variables, on the other hand, specify the conditions under which the variable exerts its effect, such as ethnicity and gender [14]. Moderators attempt to describe 'when' and in 'whom' effects may occur.

Understanding the mediating and moderating role of risk factors in predicting maternal depression could not only contribute to explain the mechanism of depression, but also greatly enable us to intervene to minimize the harmful effects of depression by focusing on certain factors or on certain patient groups. We hypothesized that socio-demographic factors such as younger maternal age, Aboriginal ethnicity, low education, low income, and single mother status will increase the depression status in late pregnancy and early postpartum

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among women who have low social support, low satisfaction with their primary relationship, high stress level, increased smoking, alcohol, and recreational drug use, and less exercise in early pregnancy and late pregnancy. We also hypothesized that one or more psychosocial (e.g., social support, stress and satisfaction with relationship) or behavioural factors (smoking, alcohol, recreational drug use and exercise) measured in late pregnancy will mediate between independent risk factors (e.g., maternal age, ethnicity, education, income, marital status, smoking, alcohol, and drug use, exercise, social support, stress and satisfaction with relationship) measured in early pregnancy with depression status in late pregnancy and early postpartum. A conceptual framework is delineated with moderating and mediating role of the risk factors for antenatal and postpartum depression (Figure 1).

Materials and Methods

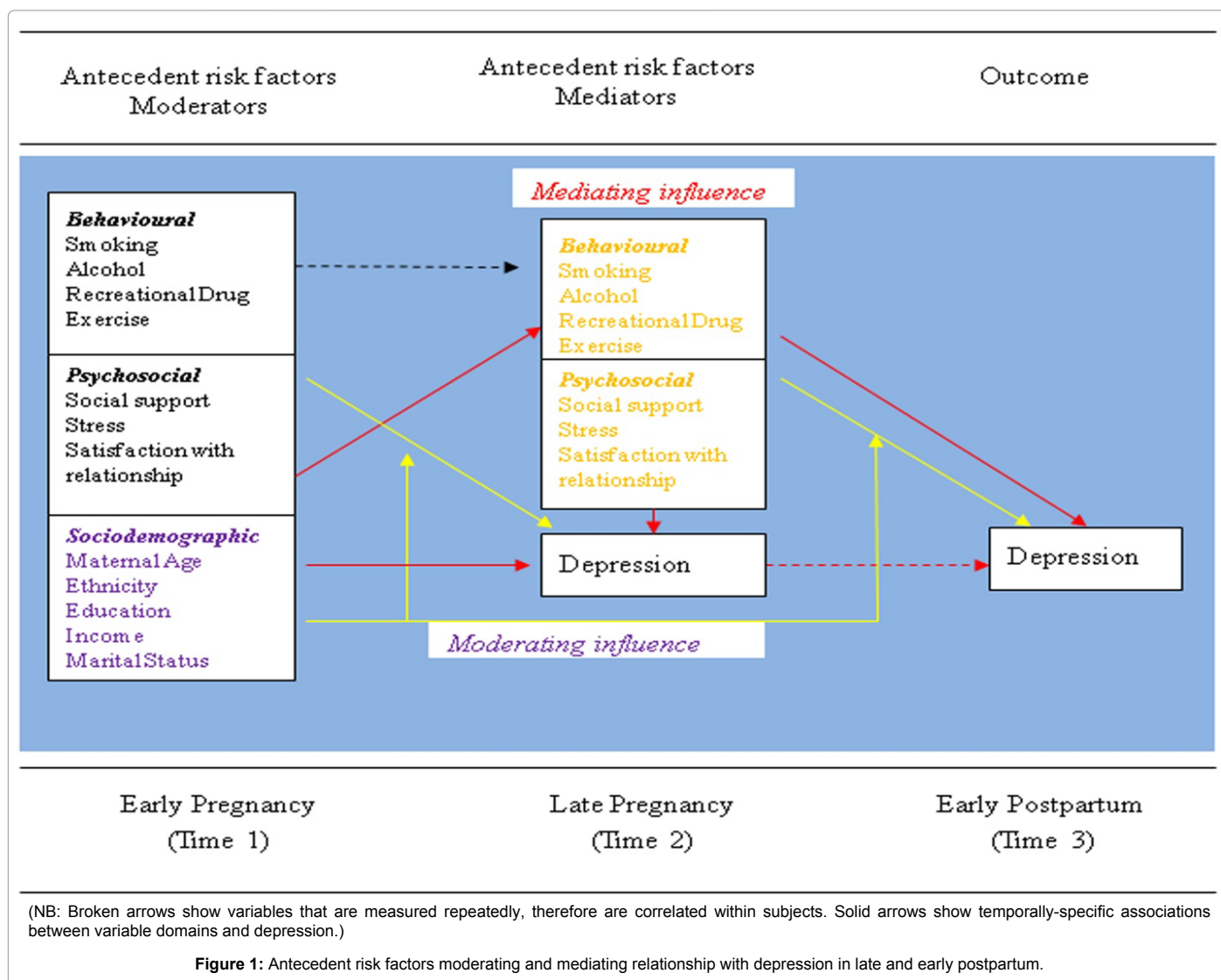
Sample

This is a longitudinal cohort study and data was collected through face-to-face interviews. There were 649 pregnant women in this study. Mothers were assessed at three points of time: Time 1=early pregnancy (17.4 ± 4.9 weeks); Time 2=late pregnancy (30.6 ± 2.7 weeks); and Time

3=postpartum (4.2 ± 2.1 weeks). Ethical approval was obtained from the Office of Research Ethics at University of Saskatchewan. Informed consent was obtained from all participants.

Measures

The outcomes of interest were depression status in late pregnancy and early postpartum, as defined by a score of 12 or more on the Edinburgh Postnatal Depression Scale (EPDS). Demographic characteristics (age, ethnicity, income, education, and marital status), psychosocial factors (stress, social support, and satisfaction with relationship), and behavioral factors (smoking, alcohol, and recreational drug use) were collected. We collected information on history of depression as this is an important predictor for antenatal and postpartum depression. However, we did not include this variable in the moderating and mediating analysis because, strictly speaking, this was not an intermediate variable in the causal chain nor was it a moderator that could be used to identify and target groups of pregnant women for specific interventions (e.g., young, Aboriginal status). Also, history of depression were likely to be co-related to the outcomes of interest as this could be recognized as a previous episode in a continuum spectrum of depression among mothers.



Analysis

Descriptive statistics of the study participants is provided in Table 1. Bivariate analysis was conducted to determine the association of the antecedent risk factors (e.g., maternal age, ethnicity, social support, stress, smoking, alcohol, drug use, and exercise) measured in early pregnancy for subsequent depression status at late pregnancy and early postpartum period. In this study, socio-demographic variables (e.g., maternal age) were considered as potential moderators, and psychosocial (e.g., social support) and behavioral risk factors (e.g., smoking) measured at late pregnancy were considered as potential mediators.

The analysis steps employed in testing the moderating and mediating role is briefly described below. The Wald chi-square test (χ^2) was used to test the significance and p value was set to <0.05.

Moderating analysis: Three hierarchical multiple regression analyses were conducted for each dependent variable, depression status in late pregnancy and early postpartum. In hierarchical regression model, the order of entry was as follows. At step 1, the predictor variables (e.g., stress) were entered into the regression equation. At step 2, the moderator variables (e.g., income) were entered into the regression equation. At step 3, the interaction of the predictor and moderator variables were included once they were significant in Step 2. Interaction terms, which were significant, were kept in the model, which indicated a significant moderating effect.

Mediating analysis: Mediating analysis traditionally involves four steps [14]. First, the predictor must correlate with the dependent variable. Second, the predictor must be related to the mediator. Third, the mediating variable must be significantly related to the dependent variable when both the independent variable and mediating variable are predictors of the dependent variable. Fourth, the coefficient relating the independent variable to the dependent variable must be larger than the coefficient relating the independent variable to the dependent variable with both the independent variable and the mediating variable included in the model. If independent variable is no longer significant when mediator variable is controlled, the finding supports a full mediating effect. If independent variable is still significant (i.e., with both independent variable and mediating variable included in the model), the finding supports partial mediating effect.

Results

Thirty-five women were lost to follow up and twenty-one did not complete the study because of fetal or neonatal loss. Study participants who did not complete the study in the postpartum were significantly

more likely to be younger age, non-partnered, Aboriginal origin, <Grade 12 education, and income <\$40,000. Participants were more likely to be greater than 25 years of age, non-Aboriginal women, in married or common-law relationships, had higher income per year, and had higher than grade 12 educations (Table 1).

Participants were more likely to be depressed in late pregnancy if they were <25 years of age, non-partnered, had income less than \$40,000, had less than grade 12 education, or were of Aboriginal origin. Mothers who 'ever smoked' or reported recreational drug use in early pregnancy were more likely to have depressive symptoms during late pregnancy. Pregnant women who reported high level of stress, had low social support, and were not satisfied with relationship were found more likely to have depressive symptoms during late pregnancy.

Participants were more likely to be depressed in postpartum if they were <25 years of age, had less than grade 12 education, or were of Aboriginal origin. Mothers who reported 'ever smoked' or reported never exercised in late pregnancy were more likely to have depressive symptoms during postpartum. Pregnant women who reported high level of stress, had low social support, and not satisfied with relationship were more likely to have depressive symptoms during postpartum.

Moderating analysis

There were six moderating effects for late pregnancy and one moderating effect for postpartum reported (Figure 2). The first significant moderator was income. This suggested that low income women who were in poor partner relationships ($\beta=1.54$; $p<0.05$) were more likely to be depressed compared to higher income women. The second significant moderator was marital status. This suggested that partnered women who reported recreational drug use ($\beta=-1.62$; $p<0.05$) were likely to be depressed compared to non-partnered mothers. The third moderating analysis showed that mothers <25 years of age with low social support had more depressive symptoms at late pregnancy compared with mothers >25 years of age. The fourth moderating analysis found that Aboriginal mothers with low social support were likely to be depressed at late pregnancy compared with non-Aboriginal mothers. Also, Aboriginal mothers with poor satisfaction with relationship were more likely to have depressive symptoms than non-Aboriginal mothers with poor satisfaction with relationship. The sixth moderating effect for late pregnancy suggested mothers who 'ever smoked' in early pregnancy in low income group were more likely to be depressed.

In moderating analysis for postpartum, one protective behavioral factor, exercise status at late pregnancy, was moderated by ethnicity in predicting depressive symptoms at postpartum. Aboriginal mothers who reported having never exercised during late pregnancy were more likely to be depressed in postpartum compared with non-Aboriginal mothers.

Mediating analysis

In predicting depression status in late pregnancy, 27 mediating pathways were found significant through 5 different mediators. These five mediators are stress (two pathways), social support (five pathways), partner relationship status (six pathways), smoking (seven pathways), and recreational drug intake (seven pathways) at late pregnancy. There were nine pathways that fully mediated the effects between independent variables and dependent variable at late pregnancy and the rest of the pathways were partially mediated (Figures 3 and 4). In mediating analysis for postpartum depression status, 5 mediating

Variables	ParticipantsN (%)
Maternal age	
<25 years age	108 (16.6)
25 years or over	541 (83.4)
Marital Status	
Married/Common Law Partner	584 (90)
Single/Divorced/Separated/Widowed	65 (10)
Income status	
\$40,000 or over	432 (66.6)
<\$40,000	206 (31.7)
Education Attainment	
<12 grade	33 (5.1)
12 grade or over	616 (94.9)
Ethnicity	
Aboriginal	55 (8.5)
Non Aboriginal	593 (91.4)

Table 1: Characteristics of the participants.

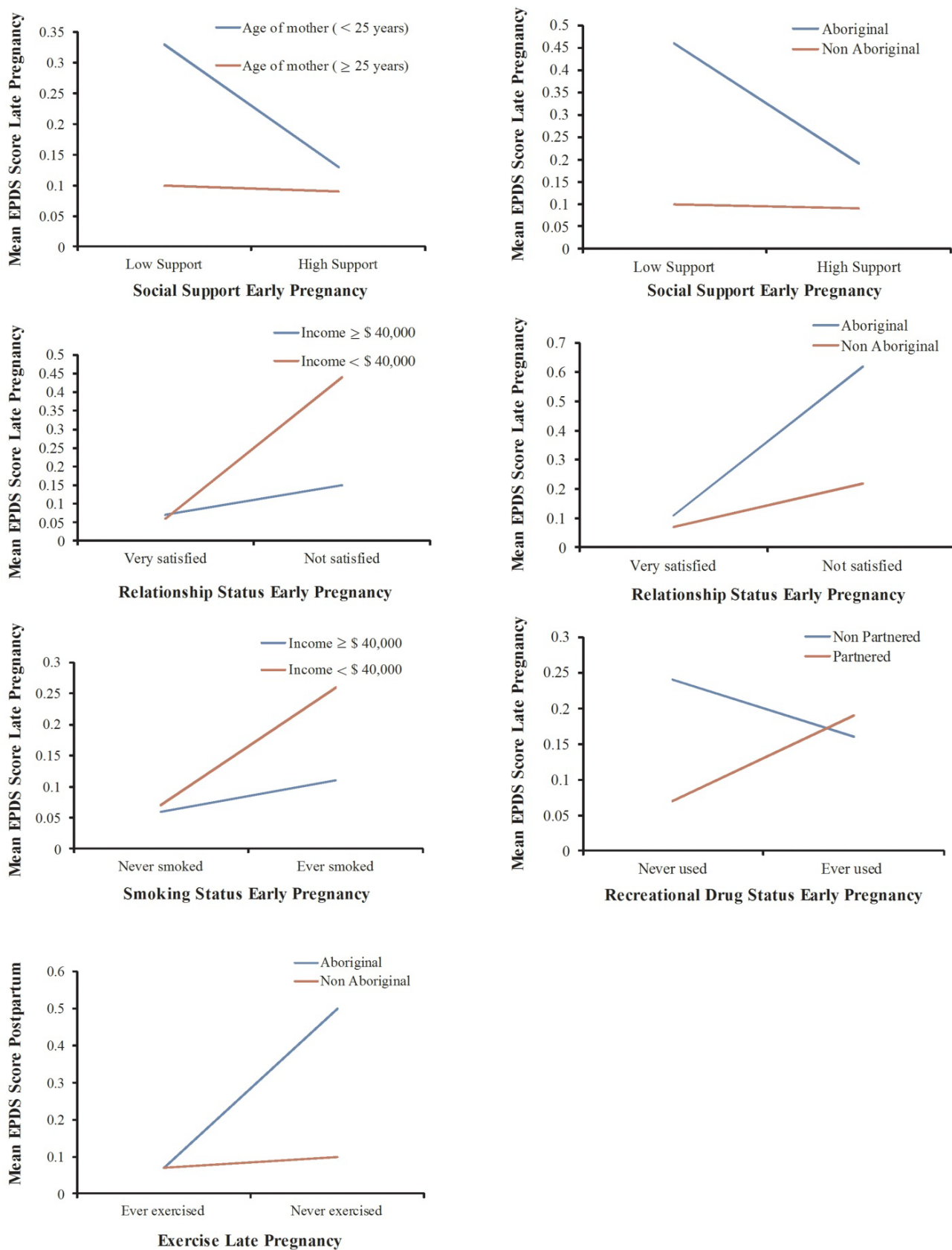
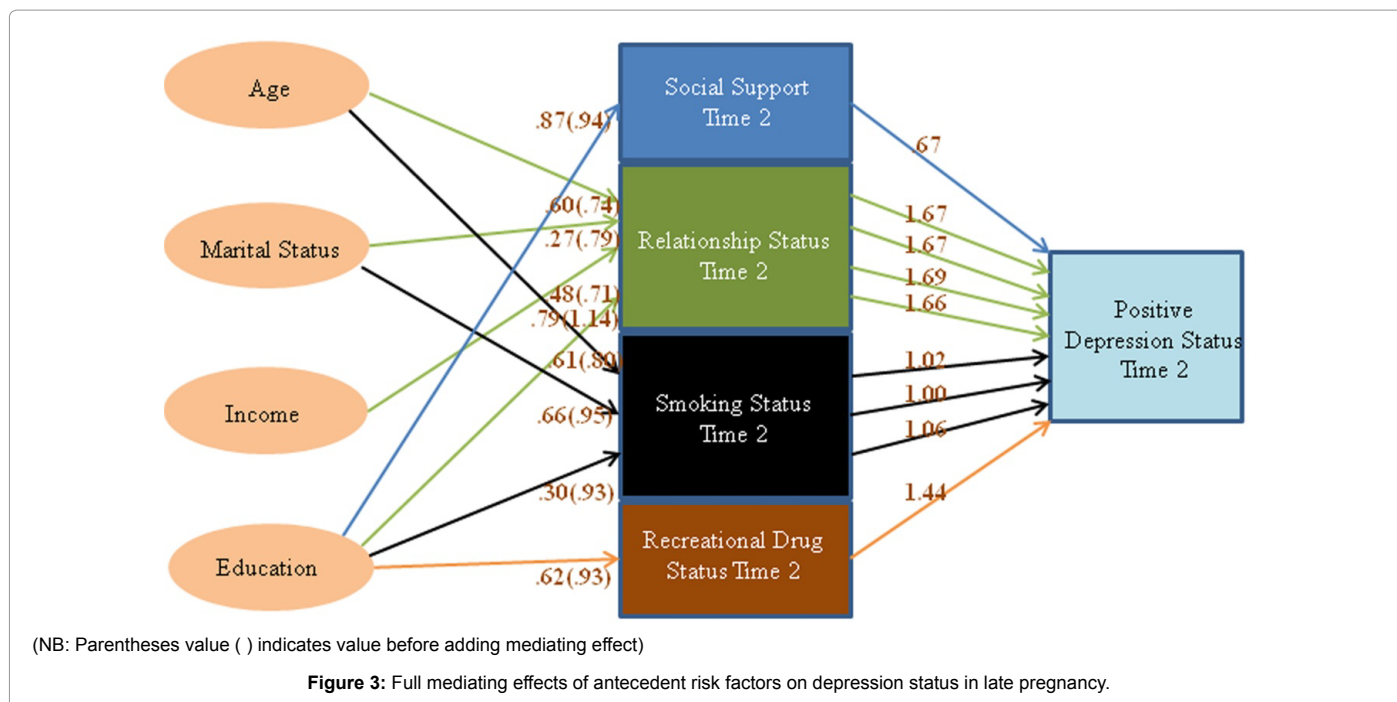


Figure 2: Moderating effects of antecedent risk factors for late pregnancy and early postpartum.



pathways were found as significant, and these pathways were mediated through a single mediator variable, smoking at late pregnancy.

Discussion

This paper examines the moderating and mediating role of the antecedent risk factors for depression status at late pregnancy and postpartum period.

Moderating and mediating effects on late pregnancy depression

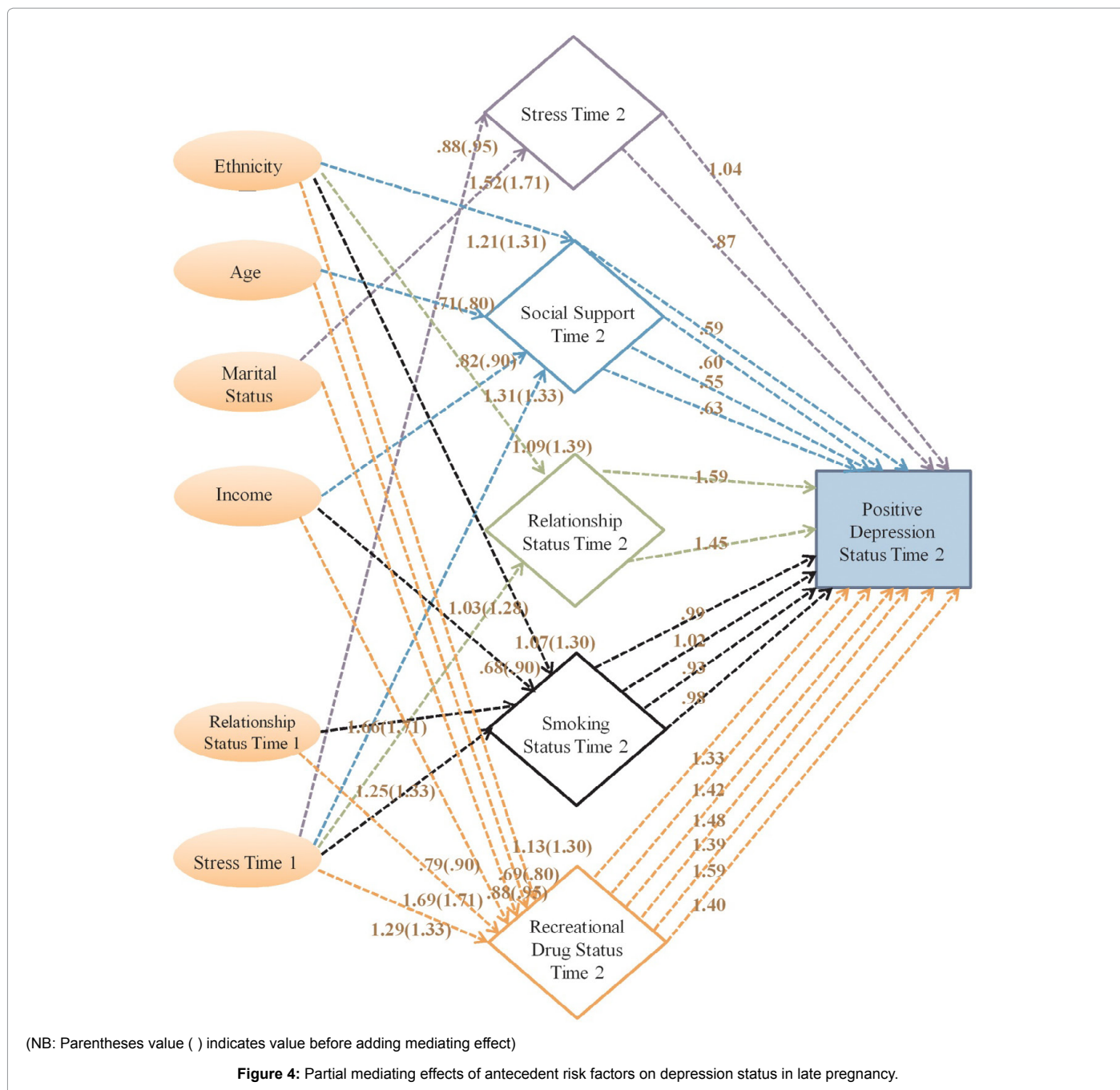
In moderating analysis, income and marital status significantly moderated the relationship for depressive symptoms at late pregnancy. We found that the negative effects of poor satisfaction with relationship in early pregnancy on late pregnancy depressive symptoms were heightened among low-income mothers. Previous research had also revealed lower education, lower income, and low social support are correlated with lower marital satisfaction during pregnancy [16,17]. Marital satisfaction has been reported as an important predictor in the transition to parenthood [18], for personal well-being [19], parental involvement [20], and infant attachment and security [21]. Therefore, our finding that lower satisfaction with marital status earlier in pregnancy coupled with lower income confers significantly elevated risk for depression at a subsequent stage in pregnancy is important because it further articulates the mechanisms by which lower income impacts healthy pregnancy.

Mothers who were in partnered relationships and reported using recreational drugs in early pregnancy had heightened risk of depressive symptoms in late pregnancy. Previous studies have shown that pregnant women whose intimate partners use recreational drugs are influenced by their partners' behavior [22]. We have looked further into recreational drug use at early pregnancy whether it was related to relationship status at early pregnancy and found a significant negative impact of poor partner relationship at early pregnancy in the 'ever drug use' mothers which heightened their depression in late pregnancy.

Another possible explanation is that recreational drugs were used to counteract the depression as a result of poor relationship status (i.e., 'self-medication').

This study reported Aboriginal women with poor partner relationship or low social support were likely to have depressive symptoms during late pregnancy. Lower education, income, and social support were found in other studies to predict poor marital satisfaction during transition to parenthood [16,17]. While satisfactory partner relationship and having a high social support are both important protective factors for depression among women [23], Aboriginal mothers in the mainstream (non-Aboriginal) society experience challenges that non-Aboriginal mothers likely do not experience. Aboriginal mothers experience much inequity such as lower education, low income, and poor social support compared to non-Aboriginal mothers, ultimately increase the vulnerability for antenatal depression [24].

In terms of findings related to mediating effects on depression in late pregnancy, we reported that stress in late pregnancy mediated the effects of marital status and satisfaction with relationship in early pregnancy. It is apparent that single mothers and those who had lower satisfaction with their partnered relationships are likely to experience stress. Single mother status and those with lower satisfaction with their relationships may lack emotional support and therefore were not able to mount any buffer on the effects of stress, which, in turn, heightened the risk for depressive symptoms in pregnancy. Also, lower education, young maternal age, lower income, and high stress in early pregnancy were partially or completely mediated through low social support in contributing antenatal depression. Stress, social support, relationship status have complex relationships with depression. According to the stress process theory [25], social support mediates social stress for symptomatic manifestation of stress, which is psychological (e.g., depression), emotional, or physical outcomes. In addition, partner support may indirectly mediate the stress by curbing the extent and intensity of stress outcomes [26]. Our mediating analysis also supported this theory.



The effects of young maternal age, single marital status, low education, Aboriginal ethnicity, low income, poor relationship status and high stress in early pregnancy were partially or completely mediated through smoking and drug use in late pregnancy in predicting depressive symptoms in late pregnancy. Low education, unmarried, and low income are found as risk factors for continued smoking in pregnancy [27-29]; but no study has reported earlier the mediating relationship between antecedent risk factors and depression for smoking or recreational drug use. The causality of smoking risk precedes or follows depression status is still unresolved [29,30]. A neuro-biological mechanism may persist for nicotine addiction that makes difficult for the mothers to quit smoking [31]. Smoking, alcohol and substance are used as coping strategies to manage the stressors

[32]; and women are found to quit after learning about their pregnancy [33]; but if mothers are depressed or has unwanted pregnancy, they might use drugs as well as smoking and alcohol [33].

Moderating and mediating effects on postpartum depression

For postpartum depression, ‘ethnicity’, moderated the relationship of exercise status. Aboriginal mothers were likely to be depressed if not exercised. Depressive status was not different among Non-aboriginal women whether they exercise or not. Non-aboriginal mothers were probably protected from depression if they have adequate knowledge of leading a healthy lifestyle or they live in neighborhoods which promote healthy lifestyle [34]. Aboriginal mothers who lack such resources, knowledge, or place might indirectly predicted depression in

pregnancy. Young age, single marital status, low education, Aboriginal ethnicity, low income, poor relationship status and high stress in early pregnancy were partially or completely mediated through smoking at late pregnancy for postpartum depression. It is possible that it could be harder for mothers to quit smoking even they are pregnant and introducing smoking cessation program in this targeted population would be important to consider.

A longitudinal study design, face to face interviews, and EPDS scale use [35] are the key strengths of this study. We used logistic regression for examining moderating and mediating relationship. Logistic regression is well known for robustness, flexibility, and easy and meaningful interpretation [36]. Among study limitations, participants were more likely married or partnered, well educated, and higher income compared with women in general population [5]. Therefore, study findings should cautiously be generalized. Also, we did not use clinical diagnosis for confirming depression [37]. Next, we did not check reverse causation in this study. Additionally, timing of data collection may be a limitation if it happened before mothers suffer from depression. The current study provides an empirical framework for the researchers through testing the mediating and moderating effects of antecedent risk factors for subsequent depression over a period. In consideration of the probable mechanisms, these findings may help the policymakers to design effective community interventions aimed at improving risk factors for depression during pregnancy and postpartum.

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KR is the primary author and he analyzed the data and wrote the manuscript. AB contributed to the design and conducting of the study, edited the manuscript, and helped with the interpretations. NM contributed to the study design, design of analysis, and edited manuscript and helped with the interpretations.

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