PRENATAL MATERNAL STRESS AND PRETERM BIRTH

PRENATAL MATERNAL STRESS AND PRETERM BIRTH: A LIFE COURSE PERSPECTIVE

By

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Abstract

BACKGROUND: Prenatal maternal stress has been implicated in having a role in adverse health outcomes across the life span. Despite its potentially pervasive effects and population health significance, research examining the determinants of prenatal maternal stress is limited and inconclusive. One particularly intractable outcome, preterm birth, has shown inconsistent associations with prenatal maternal stress. In addition, few measures of childhood perceived stress and perceived stress in pregnancy exist. **OBJECTIVE:** The purpose of these papers is to: present the theoretical foundation, conceptualization, and evidence base for the Life Course Stress and Preterm Birth Model; test and refine the Life Course Stress and Preterm Birth Model by evaluating the fit of the proposed model of stressors related to socioeconomic position (SEP) and family environment during childhood and pregnancy, perceived stress in pregnancy, and preterm birth; and conceptualize and measure perceived stress in pregnancy and childhood perceived stress, and to evaluate the validity and reliability of these two measures. **METHOD:** We used a prospective cohort design to collect data for structural equation analysis. All women who attended pre-birth clinics at two hospitals in different communities in south-western Ontario were invited to participate; women (N = 421) completed questionnaires following their pre-birth clinic visit. **RESULTS:** The mean gestational age at the time of questionnaire

completion was 28.2 (*SD* = 5.3) weeks. Questionnaire return rate was 74%. Perceived childhood stress was moderately associated with perceived stress in pregnancy (β = .54). Adult subjective SEP had a moderate effect on stress-reduction in pregnancy (β = -.44). The main influence of childhood subjective SEP on prenatal stress was indirect by increasing adult subjective SEP and reducing childhood stress. Family cohesion in childhood and pregnancy had small, direct effects on prenatal stress, but played a greater role in increasing subjective SEP and adult family cohesion and reducing stress in childhood. Findings related to our stress measurement analysis demonstrated that perceived childhood stress and prenatal maternal stress were each conceptualized as a single, latent variable. The childhood perceived stress measure was comprised of one item related to perceived family stress and three global perceived stress items. The construct of perceived stress in pregnancy differed from childhood. Perceived stress in pregnancy encompassed items of perceived financial and family stress and global measures of recent and more distant past perceived stress, suggesting that it reflected chronic stress. Initial analyses provide evidence of reliability and validity in this sample. **CONCLUSIONS**: Perceived childhood stress had a persistent effect on stress in pregnancy after adjustment for other child and adult factors. Childhood factors played important direct and indirect roles on stress in pregnancy. Adult subjective SEP constituted the main adult

contribution. The childhood and pregnancy measures of perceived stress contribute to our understanding of the construct of perceived childhood and prenatal maternal stress and inform the timing and nature of effective prevention and intervention approaches. The Life Course Model of Stress and Preterm Birth can be used as a framework to (a) direct clinical risk assessment, (b) guide research on preconception psychosocial influences on perinatal health, (c) direct perinatal surveillance approaches, (d) influence policy and program development to include determinants of perinatal health across the life course, and (e) inform population health approaches to preconception and prenatal care.

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The fear of the Lord is the beginning of knowledge…

For the Lord gives wisdom, and from him come knowledge and understanding.

Proverbs 1:7, 2:6

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Chapter One

Introduction to Problem and Background

The content of this doctoral dissertation has been formatted as a sandwich thesis. Chapter One provides an introduction to the problem of prenatal maternal stress and preterm birth. Chapter Two describes the development of the Life Course Stress and Preterm Birth Model, Chapter Three describes the major findings of testing of the model, and Chapter Four describes the analysis of the stress measurement components of the model. The final chapter summarizes the conclusions and implications of the research.

One of John F. Kennedy's most renowned speeches noted, "We choose to go to the moon. We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard". I have often reflected upon the significance of this quote and its pertinence to this ambitious dissertation project. From the start, we acknowledged this study's inherent complexity, the challenges represented by linking together diverse scientific fields, and the integration of many pathways yet untested. However, we also recognized the vast benefits that its contributions could offer to perinatal health, chronic disease in adulthood, and stress epidemiology. As such, this dissertation is a document describing our journey as we navigated the many challenges and serves as a reminder of how much more there is to discover.

Background

The background section has been organized by the primary outcome of interest, maternal prenatal stress, and the secondary outcome, preterm birth, with further discussion related to the integration of these two issues. Throughout this thesis, stress has been defined as a process involving "a relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (Lazarus & Folkman, 1984, p. 21).

The Problem of Maternal Stress

The concept of "fetal programming" was first introduced a decade ago with growing interest in the developmental origins of adult disease (Barker, 1995), and is founded on the notion that fetal responses to adverse changes in the intrauterine environment (i.e., increased glucocorticoids from maternal stress) may result in permanent alterations, or programming, of fetal body systems (Van den Bergh, Mulder, Mennes, & Glover, 2005). Animal studies have consistently demonstrated evidence of HPA-axis changes with maternal stress (Kajantie, 2006), and a very recent study provided the first physiologic evidence for an association between human prenatal maternal stress and HPA-axis dysregulation (Entringer, Kumsta, Hellhammer, Wadhwa, & Wust, 2009). Emergent evidence of associations between maternal prenatal stress and a number of adverse outcomes in neonates (e.g., preterm birth, low birth weight)

(Ohlsson & Shah, 2008), children (e.g., cognitive, behavioural, emotional problems through to adolescence) (Van den Bergh et al., 2005), and adults (e.g., cardiovascular and metabolic disease, mental health disorders) (Kajantie, 2006) suggests that the early prenatal environment represents an important, although unappreciated, determinant of adult health.

Public Health Importance of the Problem of Maternal Stress

The potentially pervasive and long-lasting effects of prenatal maternal stress underscore its significance as a public health issue. Focusing primarily on child outcomes, Van den Bergh et al. (2005) suggest, "There is enough evidence now to warrant active research into prevention, intervention, and support programs to reduce stress or anxiety during pregnancy and their effects on child outcomes" (p. 254). However, little research has addressed reduction of prenatal maternal stress, and even less has studied its predictors, which would inform the development of preventive interventions. Most stress-reducing interventions have been delivered antenatally (i.e., indicated preventive intervention), focused on limiting more immediate perinatal outcomes, and failed to reduce adverse outcomes (Ohlsson & Shah, 2008). An expanded approach to targeting maternal stress needs to be considered in the realm of prevention intervention.

A comprehensive preventive approach that limits or prevents maternal prenatal stress should be based on several principles. Foundationally, a preventive approach to stress should incorporate a life course perspective by addressing biophysical and psychosocial influences that interact across a woman's life to produce maternal prenatal stress (Misra & Grason, 2006; Tiedje, 2003). In this regard, it would encapsulate the pre-conception period, conceptualized not only as the period immediately prior to pregnancy, but as a woman's entire life (Misra & Grason).

An evidence-based preventive approach should also be supported by basic and observational stress epidemiological research that provides etiological understanding of the effects of maternal stress on the fetal brain, the impact of the timing of stress exposure during gestation, the mechanisms by which fetal programming is translated into adverse neonatal, child, and adult outcomes, and the impact of the intervention on stress reduction. The operationalization of a prevention strategy may be enacted through routine screening and assessment using valid and reliable tools during childhood/adolescence as well as healthy woman, prenatal care, and post-partum visits. Screening and intervention programs could utilize existing services and supports in the social, educational, and health sectors to target both women and girls. A final principle of a universal approach to prevention of prenatal maternal stress

is that psychosocial indicators need to be incorporated in national- and provincial-level perinatal surveillance.

Stress prevention efforts can be widened to include secondary preventive approaches that target the infant/child of the mother who experienced prenatal stress, or who continues to experience high levels of stress in the child's early developmental years. Animal and human studies have demonstrated that healthy, nurturing postnatal environments can reduce some of the adverse effects of maternal stress on offspring by altering the maturation of the developing brain and reducing vulnerability to stress dysregulation (Shonkoff, Boyce, & McEwen, 2009; Teicher, Anderston, Polcari, Anderson, & Navalta, 2002; Viltart & Vanbesien-Mailliot, 2007). As such, reducing stress and its predictors in early childhood also represents a prime, upstream strategy for limiting the development of adult disease. In a recent article, Shonkoff et al. (2009) observe:

> An increasingly persuasive amount of research is emerging that supports the thoughtful construction of a new framework for health promotion and disease prevention. This model is based on mounting evidence that the origins of many adult diseases can be found among adversities in the early years of life that establish biological "memories" that weaken physiological systems and

> produce latent vulnerabilities to problems that emerge well into the later adult years. (p. 2257)

These authors suggest that such a model needs to be incorporated in health and social policy, and advocate for a more effective use of existing infrastructure including elementary education, early childhood education, and child welfare services in reducing stress and its contributors in childhood. This discussion is furthered in Chapter Two in a presentation of the application of the Life Course Stress and Preterm Birth Model.

Challenges Related to the Measurement of Stress

Despite the importance of childhood and prenatal maternal stress to population health, little research has addressed predictors of stress. This may be due, in part, to the challenges inherent in stress measurement. The valid and reliable measurement of stress is an essential precursor to our understanding of predictors and outcomes of stress, and influences our ability to effectively screen for psychological stress across the life course and in multiple sectors. Indeed, our ability to use limited resources efficiently hinges upon our capacity to first detect those who are most at risk for experiencing stress or its outcomes. Integrating a life course perspective into stress measurement adds an additional layer of complexity to an already challenging construct.

Despite the recognition of maternal stress as a determinant of adverse outcomes across the life course, comparatively little work has

been devoted to the development of psychometrically sound instruments that measure perceived stress across the life course, and much of the early work on life event stress is outdated. Monroe (2008) suggests that stress measurement has "at best plateaued (or flatlined)", and has been subject to "a permissive and uncritical attitude" (p. 45). A number of issues that contribute to this current dilemma are worthy of mention because they form the basis for future stress measurement research (Table 1). There is a need for valid and reliable instruments that lend themselves to brief, rapid assessments of stress in childhood and adulthood and that are appropriate for population-based screening in the health, social, and education sectors.

Table 1: *Challenges in Stress Measurement*

Childhood
Childhood measures are almost solely life-event based and do not measure perceived impact of the event(s)
Many childhood measures are designed to be completed by third-party members (e.g., teacher, parent), rather than the child (Karr & Johnson, 1987)
Most widely used childhood life event measures are 20 to 30 years old, and do not reflect the changing nature of stressors (Ryan-Wenger, Sharrer, & Campbell, 2005)
Most work has been done in children diagnosed with mental health issues (e.g., anxiety disorder, depression)
Lack of consideration of developmental aspects (Compas et al., 2001)
Pregnancy
Very few longitudinal data bases collect data on adverse early life exposures
Lack of distinction between anxiety, perceived stress, life event stress, and pregnancy-related anxiety in the conceptualization and operationalization of stress (Lobel, 1994)
Measurement of stress limited to during pregnancy (i.e., preconception exposure has not been measured)
Lack of sensitivity and specificity of current stress measures (Kramer et al., 2001)
Lack of interpretation of findings within the particular stress framework or with consideration of the specific measure used
Lack of research on predictors of stress
All stress measurement work in pregnancy has focused on ethnically diverse, socioeconomically disadvantaged women, particularly African American women
Lack of integration of stress measure within "causal" pathway (O'Campo and Schempf, 2005)
Focus on measurement of stressful life events, which are strongly related to demographic characteristics, as compared to perceived stress which is distributed evenly across demographic groups (MES, unpublished).
Most life event scales used in pregnancy are in part or wholly based on the Schedule of Recent Experiences (developed 1950s) or the Social Readjustment Rating Scale (developed 1970s) and are considered seriously outdated (Cohen, Kessler, & Underwood Gordon, 1997).

The Problem of Preterm Birth

One of the most intractable outcomes of maternal stress is preterm birth. It remains the single most important cause of neonatal mortality and morbidity in industrialized countries (March of Dimes, 2002), with rates in Canada increasing 17% from 7.0% (1995) to 8.2% (2004) (Public Health Agency of Canada, 2008). This increase has been observed primarily in mildly preterm infants (33 to 36 weeks) which has important public health consequences as the risk of mortality among mildly preterm infants is 4.5 (95% CI, 4.0-5.0) times that of term infants in Canada; moreover, the proportion of infant deaths due to mild prematurity is 8.0%, twice that of moderately premature infants born at 32 to 33 weeks gestation (Kramer, Demissie, Yang, Platt, Sauvé, & Liston, 2000).

The problem of preterm birth extends far beyond the delivery of the infant. Almost half of all pediatric neurodevelopmental issues are related to preterm birth and, in 2002 alone, almost half of the total cost for infant hospitalization in the U.S. was related to prematurity (Green et al. 2005). It is also concerning that rates of neurodevelopmental sequelae (e.g., cerebral palsy) continue to increase (Stephens & Vohr, 2009). As such, in addition to substantial immediate costs related to neonatal mortality and morbidity, considerable ongoing costs are incurred by the health care system through continuing medical care requirements, the educational system through special education needs, and the social costs adopted by

the family and society in the form of reduced work and caregiver burden (Petrou, 2005; Petrou, Sach, & Davidson, 2001). These enduring economic, educational, and social costs provide a compelling argument for a shift to a preventive approach to preterm birth.

However, numerous challenges exist with respect to preventing preterm birth. The cause of prematurity is undefined in over 50% of all preterm births (Cross, 2003). Our understanding of the etiology of preterm birth is "elusive" (Kramer et al., 2009), and our current approach of targeting high risk women has been ineffective (Heaman, Sprague, & Stewart, 2001). Furthermore, our screening methods exhibit low sensitivity (Honest et al., 2004) and are based solely on biophysical profiles. Therefore, a universal, population-based approach has been advocated to address rising rates of preterm birth and its sequelae (Heaman, Sprague, & Stewart, 2001). We would further advocate that preterm birth prevention efforts must be founded on a life course perspective that considers the influence of determinants in early life, as well as adulthood. A life course approach would represent a radical shift in health service delivery from selective and indicated prevention and intervention (i.e., to stop preterm labour) to universal preconception care directed at girls and women before pregnancy occurs.

Maternal Stress and Preterm Birth

In order to inform prevention and risk assessment efforts, a recent trend in preterm birth research is the investigation of preterm birth etiology. Stress has been identified as a key determinant of preterm birth by national bodies in both the U.S. (Green et al., 2005; Institute of Medicine, 2006) and Canada (Canadian Perinatal Surveillance System). The fact that one-quarter of studies exploring stress and prematurity were published during the past year attests to the growing interest in this problem. Some inconsistency exists regarding the relationship between stress and preterm birth, and may be related to the diverse approaches to stress measurement, lack of definition of causal pathways (Kramer et al., 2001), lack of understanding of basic physiological processes governing premature parturition (Kramer et al., 2009), lack of consideration of the timing of stress exposure, and examination of stress exposure only during pregnancy. Overall, recently published studies are providing evidence strengthening this association (Glynn, Dunkel Schetter, Hobel, & Sandman, 2008; Kramer et al., 2009; Lobel et al., 2008)

"Tying it All Together"

Prenatal maternal stress and preterm birth represent important public health issues because of their immediate and long-term consequences, yet both are preventable. However, little work has been devoted to exploring etiologic pathways that would support a preventive,

upstream approach, and our focus on conceptualizing adverse influences only within pregnancy may be a main limitation in disentangling the stress-preterm birth problem. Understanding preterm birth requires understanding maternal stress, and this warrants a life course perspective that acknowledges the influences of preconception stress across a woman's life. Furthermore, research, surveillance, and prevention efforts depend upon our ability to measure stress across the life course in a valid and reliable manner.

Overall Purpose of the Doctoral Study

The purpose of this study was to test and refine a theoretical model that describes the effects of specific stressors and perceived stress across the life course on preterm birth. Using a prospective cohort design, this study (a) evaluated and refined the fit of the proposed model; (b) explored the mediational and moderational effects of the family environment, socioeconomic position (SEP), and social support; and (c) tested measurement models for SEP, the family environment, and perceived stress. An overarching objective of this study was to extend current research, surveillance, and clinical approaches to maternal prenatal stress and preterm birth by suggesting the need for a life course approach in policy, prevention, and intervention.

Note: Some overlap may exist across papers in the description of the methods or sample because these papers represent research questions derived from the same study.

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Chapter Two

Conceptualization of the Life Course Model of Stress and Preterm Birth

Abstract

BACKGROUND: Prenatal maternal stress has been implicated in having a role in adverse health outcomes across the life span. Despite its potentially pervasive effects and population health significance, research examining the determinants of prenatal maternal stress is limited and inconclusive. One particularly intractable outcome, preterm birth, has shown inconsistent associations with prenatal maternal stress. **OBJECTIVE:** The purpose of this paper is to present the theoretical foundation, conceptualization, and evidence base for the Life Course Stress and Preterm Birth Model. **METHOD:** To develop the model, we conducted extensive literature reviews of empiric studies of predictors of prenatal maternal stress, stress and preterm birth, child and adolescent stress, stress physiology, stress and social support in childhood and adulthood, subjective socioeconomic position, and measurement of stress, family environment, and objective and subjective socioeconomic position. We searched multiple data bases including MEDLINE, CINAHL, EMBASE, and PsycINFO, conducted key author searches, journal hand-searches, and reference list reviews, and contacted primary authors as necessary. **CONCLUSION:** The Life Course Model of Stress and Preterm Birth can be used as a framework to (a) direct clinical risk assessment, (b) guide research on preconception psychosocial influences on perinatal health, (c) direct

perinatal surveillance approaches, (d) influence policy and program development to include determinants of perinatal health across the life course, and (e) challenge existing population health notions regarding preconception and prenatal care.

Background

Prenatal Maternal Stress

Prenatal maternal stress has been implicated in having a role in adverse health outcomes across the life span, including psychopathological, metabolic, endocrine, and cardiovascular dysfunction in adulthood (Kajantie, 2006). Prenatal maternal stress is also important in that it has been associated with adverse neonatal (Ohlsson & Shah, 2008) and maternal outcomes, including pre- and post-partum depression (Ritter, Hobfoll, Lavin, Cameron, & Gulsizer, 2000) and, if it characterizes a woman's life, may contribute to an intergenerational transmission of vulnerability to stress (Grant et al., 2006).

Of the few studies that have explored the determinants of prenatal maternal stress, most have focused on specific, disadvantaged populations including African-American (Stancil, Hertz-Picciotto, Schramm, & Watt-Morse, 2000) and rural women (Bhandari et al., 2008), and have operationalized maternal stress solely as stressful life events (i.e., not included a measure of perceived stress), or measured acute stress. In addition, most studies have explored a limited array of predictors of maternal stress, focusing primarily on sociodemographic characteristics (Rini, Dunkel-Schetter, Wadhwa, & Sandman, 1999; Whitehead et al.). Finally, studies have not typically utilized a theoretical model of stress, which has led to the lack of distinction between stressor and stress

appraisal in the measurement of stress and interpretation of findings. The potential pervasiveness of prenatal maternal stress across the life course underscores its public health significance. In order to prevent or reduce the risk of prenatal maternal stress, the etiologic pathways converging on this outcome need to be better understood.

Stress and Preterm Birth

Preterm birth, defined as delivery prior to 37 weeks gestation, represents a specific example of an intractable outcome that has been associated with prenatal maternal stress. The most consistent predictors of preterm birth are having a previous preterm delivery, infection, and low socioeconomic status (Haram, Mortensen, & Wollen; Kramer et al., 2001). Although each of these predictors is inextricably linked to maternal stress (Anath & Vintzileos, 2006; Harville, Hatch, & Zhang, 2005; Kramer et al., 2001), relatively little attention has been paid to understanding the role of psychological stress in preterm birth.

Overall, the findings of studies examining the relationship between stress and preterm birth have been largely equivocal. A number of reasons have been proposed, including the lack of conceptualization of stress (Lobel, 1994), the use of insensitive stress measures (Kramer et al., 2001), and the use of acute stress measures in pregnancy, rather than the adoption of a chronic or cumulative perspective (Tiedje, 2003). However, Kramer et al. (2001) note:

> ...the most important limitation of previous studies has been the absence of clear hypotheses linking the psychosocial factors in a clear causal hierarchy (pathway)...What is needed therefore is not more studies that examine simple bivariate associations between individual social or psychological measures and preterm birth, but rather an integrated approach that tests hypotheses about specific causal pathways and biological mechanisms. (p. 108)

Purpose

The purpose of this paper is to articulate a framework for understanding the determinants of maternal prenatal stress and preterm birth using a life course perspective. We describe pathways and evidence for child pathways to child and adult stress, adult pathways to stress in pregnancy, and pathways from stress to preterm birth. Evidence does not exist for all of the proposed pathways in the model, and few studies have linked together pathways that share evidence to study perinatal outcomes. Our goal is to provide a framework that (a) directs clinical risk assessment, (b) guides future research on preconception psychosocial influences of perinatal health, (c) directs perinatal surveillance approaches, (d) influences policy and program development to incorporate determinants of perinatal health across the life course, and (e) challenges existing population health notions regarding preconception and prenatal care.

Why a life course framework?

Secondary and tertiary prevention efforts have failed to reduce rising preterm birth rates (Green et al., 2005). A main deterrent to our ability to enact effective prevention and intervention strategies is the lack of understanding of stress-preterm birth etiology (Kramer et al., 2009). In addition, studies exploring the effects of maternal prenatal stress on preterm birth have typically "compartmentalized" women's stress into the 9-month period of pregnancy, rather than considering pre-conception stressors.

Our model begins with early childhood stress as a determinant of prenatal maternal stress. However, evidence shows that the "story" of stress actually begins not with a woman's stress in pregnancy, but with her biologic vulnerability to physiological stress dysregulation that may have been shaped in the womb or during her childhood. Given the links between stress physiology and immune functioning, she may also have an innate vulnerability to immune dysfunction (Beydoun & Saftlas, 2008).

A fetus exposed to prenatal maternal stress has greater risk for multiple adverse outcomes. Robust evidence in animal and human research has demonstrated that maternal prenatal stress is involved in fetal neuroendocrine programming (Wadhwa, 2005). Prenatal stress increases glucocorticoids, which are powerful influences on the developing structure of the fetal brain (Viltart & Vanbesien-Mailliot, 2007).

This stress-induced plasticity has been linked to developmental and psychiatric issues (including increased anxiety), and negative cognitive, behavioural, and emotional outcomes (Beydoun & Saftlas, 2008). Given that the brain continues to undergo marked postnatal development during infancy and childhood, stress exposure during these periods can also have profound, life-long effects, including: hyperactivity/hyper-reactivity of the stress system; exaggerated emotional responses; impaired cognition; dysthymia; addictive behaviours; and suppression of reproductive, thyroid, and immune systems (Charmandari, Kino, Souvatzoglou, & Chrousos, 2003; Teicher, Andersen, Polcari, Anderson, & Navalta, 2002). During adolescence, these effects are attenuated because neuronal turnover plateaus during this period (Charmandari et al.). However, the theory of allostatic load suggests the problem does not stop here. Persistent or repeated exposure to stressors that result in a constant taxing of the HPA-axis may, over time, erode the ability of the system to respond effectively (McEwen & Seeman, 1999). This deterioration in the stress system may be enhanced in the presence of existing vulnerability to stress as a result of prenatal or early life stress (McEwen, 2003).

Clearly, by the time a woman conceives, she may have experienced a lifetime of stress with an underlying vulnerability that cannot be accounted for or addressed by simply viewing stress as a pregnancy-related exposure. A salient question, then, is "Why haven't we explored

pre-conception factors with respect to adverse perinatal outcomes?" Misra and Grason (2006) contribute a compelling and somewhat controversial point to this discussion, suggesting that one of the main reasons a focus has been on prenatal care rather than a life course perspective is that public health and clinical professionals are "wedded to the notion that provision of prenatal care is fundamental to continued improvements in maternal and infant health...as an all-encompassing strategy to achieve better outcomes" (p. 165). There are numerous challenges in implementing a life course approach within clinical and policy spheres of women's health. However, an initial step is to establish an understanding of the etiology of early life influences on long-term health, which is the focus of our model.

Methods

To develop the model, we conducted extensive literature reviews of empiric studies of predictors of prenatal maternal stress, stress and preterm birth, child and adolescent stress, stress physiology, stress and social support in childhood and adulthood, subjective socioeconomic position (SEP), and measurement of stress, family environment, and objective and subjective SEP. We searched multiple data bases including MEDLINE, CINAHL, EMBASE, and PsycINFO and conducted key author searches, journal hand-searches, and reference list reviews, and contacted authors as necessary. We used existing evidence to define

relationships between variable in the model and hypothesized pathways for which no extant evidence was available.

Description of Model

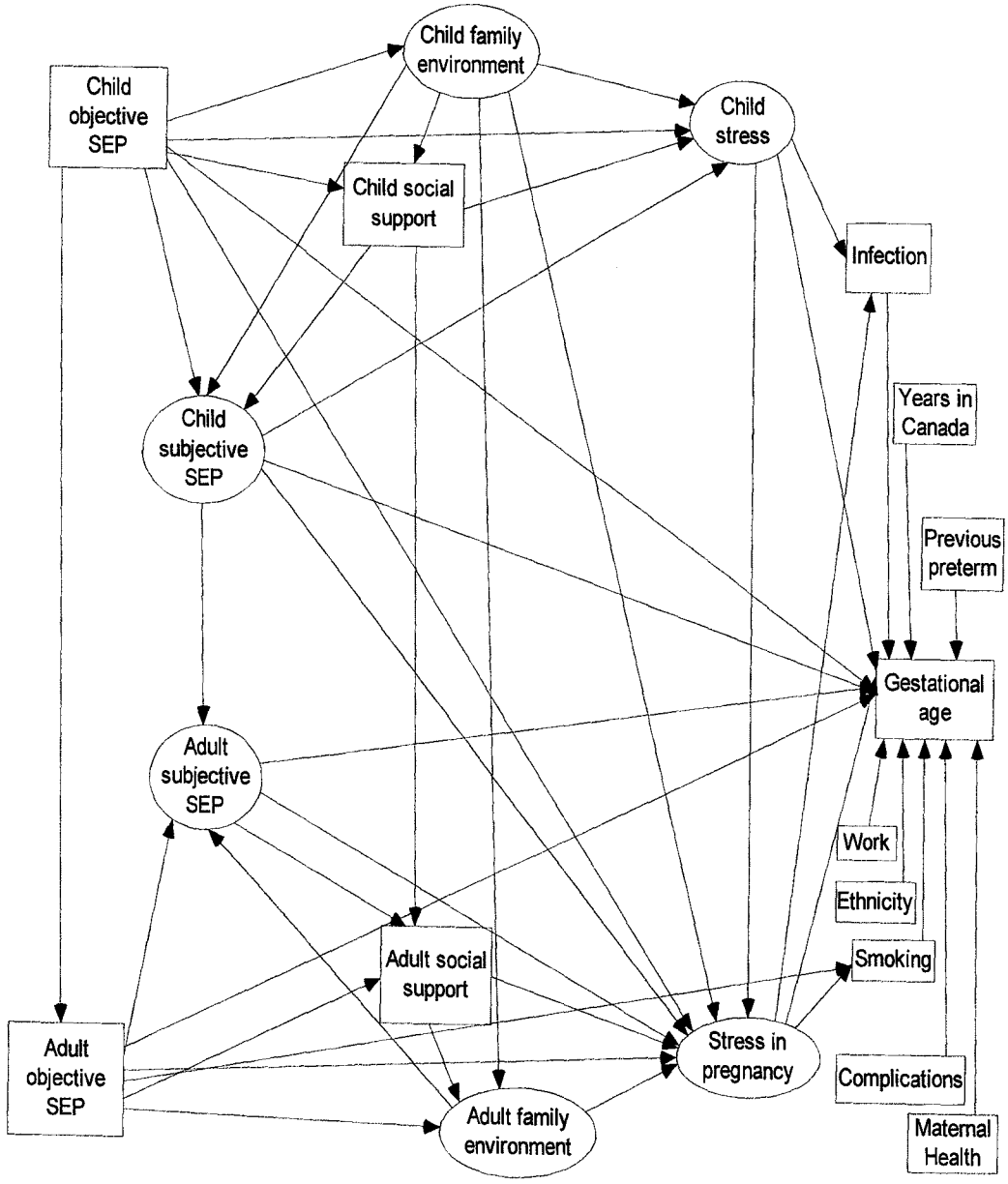
Overview of Model Structure

At its core, the Life Course Stress and Preterm Birth Model (see Figure 1) depicts relationships between stressors related to SEP and family environment in childhood and pregnancy, and preterm birth, mediated by perceived stress. The most distal exposure in the model is childhood objective SEP, found in the upper left corner of the pictorial model. Childhood pathways are found in the top half of the model, and adult pathways are in the bottom. Linkages between childhood and adulthood are represented by arrows that transverse the top and bottom halves of the model.

This model integrates psychological, behavioural, social, and biological pathways across the life course through a number of direct and indirect pathways that depict social, psychological, and biological chains of risk. The family environment, social support, objective SEP, and subjective SEP in childhood and adulthood are conceptualized as: potential sources of stress (i.e., risk factors/stressors) and protective factors; mediators through which an effect is carried forward to another variable; and finally, moderators that may influence the effect that a factor has on prenatal stress (see Figure 1). Physiological pathways involve perceived stress,

infection and gestational age, behavioural components are represented by pathways involving smoking, and obstetric and maternal risk factors include ethnicity, previous preterm birth, pregnancy complications, maternal health issues, years living in Canada, physical work, maternal age, and parity.

Figure 1. **The Life Course Stress and Preterm Birth Model.**



Assumptions

A number of assumptions underlie the conceptualization of the Life Course Model of Stress and Preterm Birth:

1. Preterm birth is the result of the interaction between multiple, diverse pathways representing biological, environmental, and behavioural factors that occur across the span of a woman's life;
2. Childhood stressors may contribute to prenatal stress and preterm birth either independently, or by influencing other stressors that occur across a woman's life;
3. Perceived stress leads to the activation of the hypothalamic-pituitary-adrenal (HPA) axis;
4. Stress that is associated with stress in pregnancy or preterm birth can begin prior to pregnancy;
5. Stress may lead to risky behaviours (e.g., smoking), which may increase the risk of preterm birth; and
6. Physiological effects of stress on preterm birth may occur through the elevation of stress hormones that activate labour processes, or through immunosuppressive processes that lead to the development of infection and inflammation.

Theoretical Underpinnings

The four main theoretical frameworks that are integrated in the Life Course Stress and Preterm Birth Model are: life course theory; transactional theory of stress; theory of allostatic load; and health disparity theory.

Life course theory. The overall structure and conceptualization of our model was based on life course theory in that our model describes pathways of early life influence on perceived stress in pregnancy and gestational age. Life course theory has been defined as, "the study of long terms effects on later health or disease risk of physical or social exposures during gestation, childhood, adolescence, young adulthood, and later adult life" (Kuh, Ben-Shlomo, Lynch, Hallqvist, & Power, 2003, p. 778). According to life course theory, five potential mechanisms exist to describe how early exposures influence adult outcomes: (a) exposure occurs during a critical or sensitive developmental period; (b) different exposures occur at different times across the life course and each exerts an independent, additive effect; (c) exposures cluster together at one point in the life course and increase risk of later adverse outcomes; (d) early exposures impact adult health directly and also increase the likelihood of later risk exposures; and (e) early risk factors are important primarily because they increase exposure to later risks (i.e., chains of risk) (Pickles,

Maughan, & Wadsworth, 2007). These underlying mechanisms may operate to varying degrees in the pathways of our model.

Transactional theory of stress. The transactional theory of stress (Lazarus & Folkman, 1984) forms the backbone of our stress conceptualization and measurement approach, and provides the critical link between our model and the underlying physiological mechanisms. Lazarus and Folkman's definition suggests that stress is "a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering to his or her well-being" (p. 19). Cognitive appraisal of a stressor involves a two-part evaluation: (a) whether the stressor poses a threat, or is benign; and (b) if perceived as a threat, whether adequate resources are available to manage the stressor. As such, stress is a *process* of exposure to an environmental stressor, appraisal, and a response to these elements. Our model explicitly describes this stress process; for example, environmental stressors (e.g., family environment) are appraised (e.g., perceived stress) and a response (e.g., preterm birth) elicited.

We have conceptualized stressors as chronic and acute, and have modeled their influence as direct and indirect. Chronic stress is differentiated from acute stress in that it comprises an environmental stressor that *remains* in the environment for a prolonged period or *continues* to exert an effect even when the stressor is absent, an appraisal

of the stressor as threatening, and biobehavioural responses (Baum, Cohen, & Hall, 1993; Miller et al.). In our model, stressors that remain in the environment or continue to exert an effect may originate in either childhood or adulthood, implying that chronic stress may vary by duration. Based on Baum and colleagues' definition, we conceptualized acute stress as that which either does not remain in the environment for a prolonged period, or does persist but with a stress appraisal that is short lived.

Theory of allostatic load. Our model also incorporates the theory of allostatic load (McEwen, 2007), which, although not tested directly, provides the underlying physiological link between stress in childhood and pregnancy. This theory suggests that persistent or repeated stress results in an over-reactive, maladaptive physiological stress response that damages biological systems (McEwen). Gerston (2007) notes that the concept of allostatic load encompasses notions that:

> (1) the body's response to challenges can carry a physiological toll and that this toll is cumulative, (2) this toll (or load) can negatively influence a wide variety of health outcomes, (3) these outcomes operate through or are a result of dysregulation of multiple physiological systems, including the neuroendocrine, immune, metabolic, and cardiovascular systems, (4) load accumulates

throughout the life course, and (5) load does not represent poor health per se, but is a predisease indicator. (p. 532)

Health disparity theory. Health disparity theory guided our conceptualization and measurement of SEP, and informed the structure of its pathways in the model. This theory suggests that health disparity may be related to absolute material disadvantage ("absolute poverty") whereby a lack of income results in direct health consequences, or a "relative" disadvantage where social comparison processes result in psychological responses that may indirectly influence health (Bartley, 2004). Our model encompasses pathways of both absolute (e.g., income, occupation, education) and relative (e.g., subjective socioeconomic position) disadvantage.

We used the concept of SEP rather than socioeconomic status (SES) because SEP includes the notions of class, status, and material assets and tends to encompass "social position" and prestige (Bartley, 2004). As such, SEP is conceptualized as both objective socioeconomic resources and subjective socioeconomic position. Objective resources include traditional indicators of wealth, income, education, and occupation, whereas subjective SEP is a measure of subjective social standing that involves the perception of an individual's place in society and in their community (Adler, Epel, Castellazzo, & Ickovics, 2000).

Description of Model Pathways and Related Evidence

We have framed our discussion of the model pathways and their evidence by four main categories: child paths to child stress; adult paths to stress in pregnancy; child paths to stress in pregnancy; and paths from stress to preterm birth.

Child Paths to Child Stress

In our model, child stress is conceptualized as both a link in a "chain of risk" to prenatal stress and gestational age, and as having independent effects on stress in pregnancy and preterm birth. As such, understanding the predictors of childhood stress is an important aspect of stress epidemiology. A case for studying childhood stress is made by Repetti, Taylor, and Seeman (2002):

> The bulk of damage done to physical health in risky families may come from the initiation of biologically dysregulated responses to stress, the effects of which may be cumulative over the lifespan. As a result, the trajectories of major causes of morbidity and mortality in developed countries...may begin as early as childhood in these biological dysregulations. (p. 336)

Socioeconomic determinants. Our model describes direct and indirect pathways between childhood SEP and child stress (Table 1). Numerous studies provide convincing evidence of the direct effects of low SEP on child health and development. In an effort to better understand

and prevent adverse outcomes, recent attention has focused on the indirect pathways through which low income has an influence on child health and development (Brooks-Gunn & Duncan, 1997). In Appendix A, we present indirect pathways from childhood SEP to childhood stress and adult stress. We acknowledge that not all pathways necessarily lead to child stress and continue to adult stress. Overall, much of the pervasive effect of childhood on future outcomes and health is a result of the intertwining of socioeconomic and family influences (Evans, 2004; Repetti et al., 2002). Children in lower income circumstances are exposed to a higher number of psychological and physical stressors (Evans & English, 2002; Taylor, Repetti, & Seeman, 1997), have fewer resources to address these stressors (Repetti et al.), and are therefore more likely to experience cumulative physiological damage across the life course. The theory of allostatic load has been substantiated in a recent study of adolescents where chronic exposure to poverty was linked to physiologic stress dysregulation (Evans & Kim, 2007).

Table 1: ***Pathways and Mediators of Pathways to Child Stress in the Life Course Stress and Preterm Birth Model***

Environmental Stressor	**Mediator**	**Outcome**
Child objective SEP	Child subjective SEP Child family environment Child social support	Child Stress
Child subjective SEP		Child stress
Child family environment	Child subjective SEP Child social support	Child stress
Child social support	Child subjective status	Child stress

Although most work has focused on the effects of low SEP, a recent review found children of affluence to be at higher risk for anxiety and, as a consequence, greater substance abuse than their disadvantaged peers (Luthar, 2003). Luthar and Becker (2002) also found that the prevalence of depression in suburban adolescent girls was elevated compared to disadvantaged adolescent girls. They reported that pathways to anxiety and depression involved achievement pressures, isolation from adults, and lack of closeness with their mothers. Adolescents in this study experienced pressure to excel at academic and

extracurricular activities to enhance their future prospects, a relatively novel stressor that was identified among "modern" children in a recent review of types of children's stressors over 30 years (Ryan-Wenger, Sharrer, & Campbell, 2005). Using repeated assessments, another study found that affluent adolescents reported less happiness than their lower income counterparts (Csikszentmihalyi, 1999).

Childhood family environment. Numerous studies have found that family dysfunction is associated with elevated levels of anxiety in children (Pagani, Japel, Vaillancourt, Cote, & Tremblay, 2008). This relationship is mediated, in part, by emotional insecurity (Davies et al., 2002), lack of perceived personal control (Chorpita & Barlow, 1998), and the perception that an event is more threatening (Chen & Paterson, 2006). These findings are supported by physiological studies. For example, Taylor et al. (2004) found that growing up in a "risky" family characterized by chaos, neglect, conflict, and non-nurturing parental relationships was associated with elevated cortisol levels and dysregulated stress responses at baseline, whereas children from warm and nurturing homes had lower baseline levels and typical stress responses. Their findings emphasize that stress dysregulation can occur with sub-clinical levels of anxiety even in a young, healthy sample of individuals from families exhibiting "normal" family strain (Taylor et al.). Other studies confirm that children from families with angry adult interactions (El-Sheikh, Cummings, & Goetsch,

1989), with parents who provided few affectionate, positive interactions and were emotionally unavailable (Flinn & England, 1997), or who experienced parental relationships characterized by low levels of warmth and high control (Chorpita & Barlow, 1998) demonstrated abnormal physiological responses to stress. A recent study demonstrated cortisol hyporesponsivity at age 15 in adolescents who experienced maternal insensitivity and much time in child care centres in their first 3 years of life (Roisman et al., 2009). The findings of this study are striking because they suggest that long-term physiologic dysregulation can occur quite early in a child's life.

In our model, we hypothesize that the effect of a child's family environment on child stress is mediated by perception of the family subjective SEP or childhood social support (Table 1). To our knowledge, no studies have examined the effect of the child family environment on child subjective SEP. However, Singh-Manoux, Adler, and Marmot (2003) suggest that subjective SEP is a result of a child's perceived composite of individual and family-based resources that provide a context for them to assess their current and future opportunities. Given the developmental role that the childhood family plays in the formation of perceptions and appraisal processes (Taylor et al., 2004), it is plausible for the childhood family to influence children's social status. The relationship between the family environment and child stress may be partially mediated by

childhood social support (Appendix A). Children raised within a harsh, non-nurturing family environment suffer from poor social support because they often lack social competence and may be aggressive or withdrawn (Repetti et al., 2002), and have parents that are less likely to support their peer relationships (Evans, 2004).

Adult Paths to Prenatal Maternal Stress

The persistent influence of prenatal maternal stress as a determinant of health across the life course is a relatively novel concept. Its importance has been brought to the forefront by research in fetal programming and the long-term effects of early life circumstances. Yet, despite its potentially pervasive effects, little research to date has explored predictors of prenatal maternal stress.

Socioeconomic determinants. Physiologic studies have found links between SEP and elevated stress hormones in adults (Cohen, Doyle, & Baum, 2006; Janicki-Deverts et al., 2007). Other studies have demonstrated a relationship between low SEP and prenatal maternal stress when measured as stressful life events (Kingston, Heaman, Fell, Dzakpasu, & Chalmers, 2009; Whitehead, Brogan, Blackmore-Prince, & Hill, 2003). The results of studies examining the relationship between SEP and perceived stress are inconsistent. One study found that higher income and lower education were related to greater perceived stress in pregnancy (Stancil, Hertz-Picciotto, Schramm, & Watt-Morse, 2000), but another

found no relationship (Kingston et al., 2009). The inconsistency in findings is likely related to the weak or absent relationships between stressful life events and perceived stress (Kingston et al.; Stancil et al.). In a large, population-based study in Canada, Kingston et al. found that only one-third of women with a high number of stressful life events perceived those events to be stressful. These findings suggest that low SEP may be a marker representing a broader context of life circumstances that are characterized by chaos, lack of structure, unpredictability, and insecure relationships (Evans, Gonnella, Macrynyszyn, Gentile, & Salpekar, 2005). No studies to date have examined the long-term effects of low SEP on stress in pregnancy, although one study found that the cumulative effect of economic hardship was a predictor of self-rated health in adult women (Ahnquist, Fredlund, & Wamala, 2007).

In our model, we propose that the effect of objective SEP on prenatal stress may be mediated by subjective SEP, the family environment, or social support in adulthood (Table 2). Citing their previous work, Singh-Manoux, Marmot, and Adler (2003) describe the relationship between objective and subjective SES, concepts that parallel SEP:

> ...subjective SES represents a cognitive average of standard markers of SES, including elements representing an assessment of current and future prospects. This "averaging hypothesis" would suggest that subjective SES is both a social and an economic

phenomenon and perhaps a better measure of SES at the individual level than any single indicator of SES. (p. 855)

Table 2: ***Pathways and Mediators of Pathways to Adult Stress in the Life Course Stress and Preterm Birth Model***

Environmental Stressor	Mediator	Outcome
Child objective SEP	Adult objective SEP Child subjective SEP Adult subjective SEP Child family environment Adult family environment Child stress	Adult Stress
Child subjective SEP	Adult subjective SEP Child family environment Adult family environment Child stress	Adult stress
Adult objective SEP	Adult subjective SEP Adult family environment Adult social support	Adult stress
Adult subjective SEP	Adult social support	
Child family environment	Child subjective SEP Adult family environment Child social support	Adult stress
Adult family environment	Adult subjective SEP	Adult stress
Child stress	Adult subjective SEP	Adult stress

Past studies have demonstrated that perceived social support and marital satisfaction can play a protective role in reducing psychological distress during pregnancy (Littleton, Breitkopf, & Berenson, 2007). However, low objective SEP has been associated with low social support within the family (Atkinson, Liem, & Liem, 1986; Wright et al., 1993; Wright, Treiber, Davis, Bunch, & Strong, 1998), as well as smaller external

social networks with less frequent contact (House, Umberson, & Lands, 1988; Evans, 2004). The mechanisms by which social support has an effect on stress are largely theoretical at this point in time. One study found that perceived social support enhanced mastery in adult women, which then reduced psychological distress (Gadalla, 2009). This relationship was substantiated in a recent physiologic study that found an association between mastery and an increased inhibition to threat responses, resulting in reduced cortisol levels (Taylor et al., 2008). Mastery has been found to be a powerful factor for reducing stress in pregnancy (Rini, Dunkel-Schetter, Wadhwa, & Sandman, 1999). Others have suggested that social support changes the way in which circumstances are appraised, leading to enhanced self-esteem or other personal resources that enable an individual to respond to their stress more effectively, or ameliorates the physiological responses to stress (Cohen, 1988; Collins, Dunkel-Schetter, Lobel, & Scrimshaw, 1993).

A relatively new concept, subjective SEP, comprises the notion that social comparison leads to a social status "ranking" based on power, coercion, and access to resources (Wilkinson, 1999). Psychobiological processes are thought to mediate the relationship between subjective SEP and health outcomes (Wilkinson). Clearly, subjective SEP differs conceptually from objective SEP (Adler et al., 2000) and some have found subjective SEP to be more predictive of psychosocial health (Singh-

Manoux et al., 2003). Few studies have linked subjective SEP to stress; however, two studies found that low subjective SEP was associated with abnormal cortisol responses in a sample of retirees (Wright & Steptoe, 2005) and college students (Gruenewald, Kemeny, & Aziz, 2006). In terms of intermediary pathways, low subjective SEP has been associated with feelings of anxiety, stress, and inequality, whereas high SEP was affiliated with feelings of security and hope that acted to buffer the effects of stress (Operario, Adler, & Williams, 2004).

We proposed that the effect of subjective SEP on stress may be partially mediated by social support (Table 2). To our knowledge, no studies have linked subjective SEP, social support, and stress. These relationships may be complex with low social support contributing to a low sense of social status, or low subjective SEP leading to poor social support. In our model, we suggested that low subjective SEP would be predictive of poor social support. Evidence across multiple countries has demonstrated that as social status differences in a society widen, the quality of social relations decreases (Wilkinson, 1999). Wilkinson suggests that this is a particularly noxious combination for population health:

> Social status and social support or social affiliation are – at least in the developed world – perhaps the two most important risk factors for population health. Both have been associated with two, three, or

> even fourfold mortality differences. While there are other factors that carry a large relative risk, there must be few with such a high-population attributable risk. (p. 50 – 51)

Individuals with low subjective status may experience insecurity, less personal dignity, lack of confidence, fear of personal inadequacy, fear of rejection, and negative evaluations from others (Wilkinson, 1999). These factors may inhibit the development of quality social supports. In particular, Wilkinson cites Scheff, Retzinger, and Ryan (1989) in suggesting that shame (e.g., feeling foolish, stupid, ridiculous, defective) is a social anxiety that is "nearly always associated with depictions of loss of status...of being devalued, disgraced, demoted, and dishonoured" (Gilbert & McGuire, 1998, p. 111). This sense of shame has also been associated with the inability to process socially threatening experiences (Gilbert, 1998). It may be that the ability to accurate process social situations may further be linked to the quality of social support that an individual with low subjective SEP can garner.

Adult family environment. In our model, we propose that the adult family environment may have a direct impact on perceived stress in pregnancy or may be mediated by adult subjective SEP (Table 2). We found no direct evidence for these paths. However, studies have found that relationship stress has a more potent effect on health than work stress (Orth-Gomer et al., 2000), and that marital adjustment predicts daily

stressful events and state anxiety during pregnancy (DaCosta, Larouche, Dritsa, & Brender, 1999). Others have found that positive couple interactions and intimacy have a physiologic effect in reducing cortisol levels, and may act through physical contact, which activates central nervous system components that respond to touch, or through positive affect (Ditzen, Hoppman, & Klumb, 2008; Steptoe, Wardle, & Marmot, 2005). Based on the effect of a nurturing family environment on reducing children's stress, we surmise that a close, warm family environment in adulthood would have a similar stress-reducing effect in adults (Repetti et al., 2002). Given that subjective SEP encompasses both economic and social aspects, we hypothesize that a healthy family environment contributes to a higher sense of subjective SEP.

Child Paths to Prenatal Maternal Stress

We know of no studies that have explored childhood determinants of prenatal maternal stress. However, distal influences are important for maternal health because they shape the context that contributes to greater susceptibility to proximal risk factors (Misra, Guyer, & Allston, 2003; Poulton & Caspi, 2005). Moreover, the concept of allostatic load directs our attention to the physiological consequences of long-term exposure to stress (McEwen, 2007).

Socioeconomic determinants. Childhood objective SEP represents the most distal influence in our model. Direct, robust

relationships have been found between high childhood objective SEP and improved adult physical and mental health (Muntaner, Eaton, Miech, & O'Campo, 2004; Schoon, Sacker, & Bartley, 2003). However, no studies were found linking childhood SEP to adult stress. Of the three studies that examined the relationship between childhood objective SEP and adult *distress*, none found a direct effect after adjusting for adult factors (Kuh, Hardy, Rodgers, & Wadsworth, 2002; Lehman, Taylor, Kiefe, & Seeman; Power, Stansfeld, Matthews, Manor, & Hope, 2002).

Direct effects of SEP on health outcomes suggest that material advantage/disadvantage itself has an effect on health, which supports the theory of absolute poverty (Bartley, 2005). However, it is more likely that the effects of childhood SEP on psychosocial outcomes are indirect with multiple, complex sociopsychological pathways (Muntaner et al., 2004). Interest in understanding the mechanisms by which objective and subjective SEP exert their effects has burgeoned in recent years (Appendix A). However, very few studies have examined the relationship between objective and subjective SEP and child or adult stress. We suggest that perceptions of comparative social status formed in childhood are enduring, and may contribute to adult stress and/or a sense of subjective SEP. The mechanisms underlying this notion are unclear, although recent physiological studies suggest that low perceived social standing in childhood and young adulthood are associated with markers of

chronic stress in young adults (Gianaros et al., 2008; Grunewald et al., 2006).

As previously discussed, family objective SEP may lead to child stress. It is also possible that this pathway may contribute to stress in adulthood. Physiologic evidence exists for an association between early life adversity and cortisol dysregulation in adults (Gonzalez, Jenkins, Steiner, & Fleming, 2009). Although the pathways explaining this relationship are largely untested, it is plausible that patterns of enhanced threat appraisal (Chen et al., 2004), inferior coping styles (Olff, Langeland, & Gersons, 2005), lack of mastery and control (Olff et al.), and reduced social support (Olff et al.) may produce a persistent, dysregulated stress appraisal and response system that results in high levels of adult stress.

We propose that the effects of childhood objective SEP on the childhood family may translate into enduring consequences for the adult family. For example, the family profiles associated with both low SEP (e.g., harsh parenting, lack of warmth in parent-child relationship, low responsivity) and high SEP (e.g., neglect and isolation) (Luthar, 2003; McLeod & Shanahan; Taylor et al., 2004; Yeung, Linver, & Brooks-Gunn, 2002) may result in a dysfunctional relationship or parenting patterns that become observable in the adult family. Additionally, the stress that results from "risky" childhood family characteristics may endure into adulthood, either directly or through enhanced stress vulnerability.

Our model also includes a direct pathway from childhood subjective SEP to stress in pregnancy, as well as an indirect path through adult subjective SEP (Table 2). To our knowledge, no studies have explored either pathway. However, we hypothesize that perceptions borne from social comparisons in childhood (e.g., insecurity, lack of confidence, fear of personal inadequacy) can endure into adulthood either in the form of chronic stress (Wilkinson, 1999) or in a contributory role in shaping adult subjective SEP.

Family determinants. Our model describes pathways between the childhood family environment and stress in pregnancy. We propose that while this may be a direct effect, as demonstrated by Lehman et al. (2005), it may also be indirect through childhood stress, stress in pregnancy, the adult family environment, child social support, or child subjective status (Table 2).

Evidence consistently supports the link between "risky" family environments and stress in childhood. A few studies have found a similar relationship between childhood family adversity and stress in adulthood. For example, the childhood family environment has been found to increase a child's stress through parental practices that do not nurture stress-reducing coping patterns or a sense of control (Chorpita & Barlow, 1998; Taylor, Lerner, Sage, Lehman, & Seeman, 2004), family conflict (Davies et al., 2002), and unresponsive parenting and maternal

insensitivity (Gump, Matthews, & Raikkonen, 1999; Roisman et al., 2009). In another study, "cumulative" family turmoil and SEP resulted in chronic dysregulation of the stress response system in young adolescents, a relationship that was mediated by maternal responsiveness (Evans, Kim, Ting, Tesher, & Shannis, 2007). Other studies provide evidence of a physiological link between childhood family adversity and stress in non-pregnant (Meinischmidt & Heim, 2005), and pregnant women (Shea et al., 2007).

Child perceived stress as a determinant. Our model depicts a direct relationship between perceived stress in childhood and perceived stress in pregnancy. To date, no studies have explored this relationship. Although not tested directly, the underlying physiologic mechanism is hypothesized to be allostatic load, the concept that repeated or enduring stressors cause frequent activation of the stress regulatory system, resulting in physiologic wear and tear on these body systems (McEwen & Seeman, 1999). Chronic stressors have been linked to allostatic load in older adults, and perceived stress was found to mediate this relationship (Glei, Goldman, Chuang, & Weinstein, 2007). Importantly, allostatic load has been found to be associated with stressors in adolescence (family turmoil, poverty) that were measured only 3 years previously (Evans et al., 2007).

Paths from Stress to Preterm Birth

An understanding of the stress physiology underlying preterm birth is important not only because it connects psychological and biological phenomena, but also because this knowledge may generate biologic or psychologic markers that can be used to screen women at risk for preterm birth. Physiologically, stress may exert its effect on preterm birth through two main pathways: neuroendocrine and immune-inflammatory. Behaviourally, stress may lead to the adoption of risky behaviours, which may then influence preterm birth. Our model has pathways that indirectly and directly reflect these processes.

The neuroendocrine pathway. The neuroendocrine pathway involves the stimulation of the HPA-axis by a stressor, resulting in secretion of corticotrophin-releasing hormone (CRH), adrenocorticotropin hormone, and cortisol (for a detailed review see Wadhwa et al., 2001). Elevated CRH and cortisol have been implicated in premature initiation of parturition. In our model, the perceived stress – gestational age pathway presumes that perceived stress stimulates the neuroendocrine response, and this is supported by the little available evidence that has linked perceived stress to CRH in pregnant women (Hobel, Dunkel-Schetter, Roesch, Castro, & Arora, 1999) and cortisol (Kalra, Einarson, Karaskov, Uum, & Koren, 2007). However, others have not found a significant relationship between perceived stress and CRH or cortisol (Kramer et al.,

2009). Recent studies suggest that this discrepancy may exist because it is the *change* in CRH or cortisol levels, rather than the level at a single point in time, that is predictive of preterm birth (Glynn, Dunkel-Schetter, Hobel, & Sandman, 2008).

The immune – inflammatory pathway. The immune-inflammatory pathway is represented by the stress-infection-gestational age pathways in our model. Stress depresses systemic and local (placental-decidual) immunity, increasing the risk of infection, inflammation, and early parturition (Wadhwa et al., 2001). Consistent associations between psychosocial stress, infection/inflammation, and preterm birth have been found (Coussons-Read, Okun, Schmitt, Giese, 2005; Coussons-Read , Okun, Nettles, 2007; Klein & Gibbs, 2005; Ruiz, Fullerton, & Dudley, 2003). In our model, we link childhood experiences with infection. Based on the theory of allostatic load (McEwen, 2007), we propose that the dysregulation in the stress and immune systems may have early roots resulting from chronic activation and physiological weathering. No studies to date have empirically tested these ideas. However, there is evidence for the impact of early life adversity on stress (Gonzalez et al., 2009; Janicki-Deverts et al., 2007; Meinischmidt & Heim, 2005; Roisman et al., 2009; Shea et al., 2007) and immune functioning (Shirtcliff, Coe, & Pollak, 2009). This research provides insight into mechanisms through which early life influences are translated into physiological changes in adulthood.

Behavioural pathway. The most studied form of risky behaviour in preterm birth research is maternal smoking. Robust evidence exists for this relationship as demonstrated by observational evidence linking smoking and increased risk of preterm birth (Heaman et al., 2005; Heaman et al., 2009; Ohlsson & Shah, 2008) and smoking cessation in early pregnancy and reduced risk of preterm birth (Polakowski, Akinbami, & Mendola, 2009). Less research has been conducted on the association between prenatal stress, smoking, and preterm birth. However, a recent study found that pregnancy-specific stress contributed to smoking, which increased the risk of low birth weight, but not preterm birth (Lobel et al., 2008). No studies were found exploring the influence of chronic stress on risky behaviours in pregnant women.

Application of this Model

Stress poses a unique problem in that it underlies many health issues, transverses the life course, affects both advantaged and disadvantaged individuals, and is modifiable. We have used the framework of our model to generate clinical, surveillance, research, and policy implications. Our model can be used to expand current biophysical risk screening and assessment approaches to include psychosocial health indicators that are evaluated not only in pregnancy, but also as part of routine child and well-women's care. This has application for both clinical settings and perinatal surveillance. Our model can also guide research on

preconception psychosocial influences on perinatal health. Specifically, it can inform the development of psychosocial risk assessment instruments for clinical use and indicators for surveillance. Our model also provides a framework for understanding the etiology of stress and preterm birth, and acts as a foundation for the development of other life course-based stress-preterm birth models. In terms of policy, we hope that our model challenges existing thinking regarding the delivery of women's care. Our model implicates that psychosocial assessment, care, and education should represent components of the well-child and well-woman's visit and prenatal care. Expanding this notion beyond health, psychosocial care across the life course may also encompass points of contact within the social and educational sectors, as well as occupational settings.

Conclusion

The notions proposed in this paper echo the sentiments of clinicians, researchers, and political advocates for a broader, population-based approach to the problem of preterm birth (Heaman, Sprague, & Stewart, 2001; Mattison, Damus, Fiore, Petrini, & Alter, 2001; Tiedje, 2003). We extend this call by emphasizing the importance of early life influences and, in particular, prenatal maternal stress. An "upstream" population-based approach (Butterfield, 1990) to preterm birth requires that we address the most distal factors within our awareness. The broad base of evidence supporting the impact of prenatal maternal stress

suggests that stress-reducing measures that are offered in pregnancy may be initiated too late. Given the unpredictability of many stress-related perinatal outcomes, we would be well-advised to direct part of our limited resources to early intervention and prevention.

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Chapter Three

Pathways to Maternal Stress and Preterm Birth: Testing a Life Course Model

Abstract

OBJECTIVE: Prenatal maternal stress has been implicated in having a role in preterm birth. The purpose of this study was to test and refine the Life Course Stress and Preterm Birth Model by evaluating the fit of the proposed model of stressors related to socioeconomic position (SEP) and family environment during childhood and pregnancy, perceived stress in pregnancy, and preterm birth. **METHODS:** We used a prospective cohort design to collect data for structural equation analysis. All women who attended pre-birth clinics at two hospitals in different communities in south-western Ontario were invited to participate; women (N = 421) completed questionnaires following their pre-birth clinic visit. **RESULTS:** Mean gestational age at the time of questionnaire completion was 28.2 (*SD* = 5.3) weeks. Questionnaire return rate was 74%. Perceived childhood stress was moderately associated with perceived stress in pregnancy (β = .54). Adult subjective SEP had a moderate effect on stress-reduction in pregnancy (β = -.44). The main influence of childhood subjective SEP on prenatal stress was indirect by increasing adult subjective SEP and reducing childhood stress. Family cohesion in childhood and pregnancy had small, direct effects on prenatal stress, but played a greater role in increasing subjective SEP and adult family cohesion and reducing stress in childhood. **CONCLUSIONS:** Perceived childhood stress had a persistent effect on stress in pregnancy after

adjustment for other child and adult factors. Childhood factors played important direct and indirect roles on stress in pregnancy. Adult subjective SEP constituted the main adult contribution. These findings can be used to enhance psychosocial risk screening, assessment, and interventions across a woman's life.

Background

Prenatal Maternal Stress

Maternal stress has been identified as a key psychosocial determinant of preterm birth, and one that is potentially modifiable. Preterm birth (gestational age <37 weeks) remains the single most important cause of neonatal mortality and morbidity in industrialized countries, and despite screening and clinical intervention, rates continue to increase (Green et al., 2005; Public Health Agency of Canada, 2008). Current methods of screening and detection for preterm birth are largely based on biomedical risk factors, and identify less than half of women "at risk" for preterm birth (Honest et al., 2004). The long-term economic, educational, and social costs associated with preterm birth underscore its significance as a public health concern.

An "upstream" approach to preterm birth requires that we recognize that preterm birth is "more [of] a chronic process than an acute one" (Iams, 1998, p.55) and the result of multiple, complex pathways (Tiedje, 2003). Although the physiological pathways that link prenatal stress and preterm birth remain "elusive" (Kramer et al., 2009), present hypotheses suggest that stress elevates corticotrophin releasing hormone (CRH) resulting in early parturition, or suppresses immune function, leading to infection and inflammation (Wadhwa et al., 2001). Prenatal maternal stress has also been associated with other adverse perinatal outcomes, including low birth

weight (Ohlsson & Shah, 2008), reproductive losses and infertility (Nakamura, Sheps, & Arck, 2008), congenital anomalies (Carmichael, Shaw, Yang, Abrams, & Lammer, 2007), and prenatal and postpartum depression (Ritter, Hobfoll, Lavin, Cameron, & Hulsizer, 2000). The "fetal programming" hypothesis further suggests that maternal stress causes physiological and structural changes in the fetal HPA-axis, resulting in chronic disease in adulthood including coronary heart disease, Type 2 diabetes, stroke, hypertension, and depression (Kajantie, 2006).

Although stress is an important contributor to adverse health outcomes across the life span, multiple challenges exist in disentangling the effects of stress in pregnancy. The conflicting findings observed in the perinatal stress literature may be related to (a) lack of delineation of causal pathways (Kramer et al., 2001), (b) studying proximal (i.e., recent) but not distal (i.e., past) influences (James, 1993), (c) exclusion of behavioural and biological factors in psychosocial models of stress (Tiedje, 2003), and (d) a focus solely on stress during pregnancy versus the adoption of a life course approach. Furthermore, interventions to reduce prenatal stress have largely been ineffective in reducing the risk of adverse perinatal outcomes (Ohlsson & Shah, 2008). Given that stress has a more profound effect on preterm birth when it occurs during the first trimester (Glynn, Wadhwa, Dunkel-Schetter, Chicz-DeMet, & Sandman, 2001; Glynn, Schetter, Wadhwa, & Sandman, 2004), stress-reduction

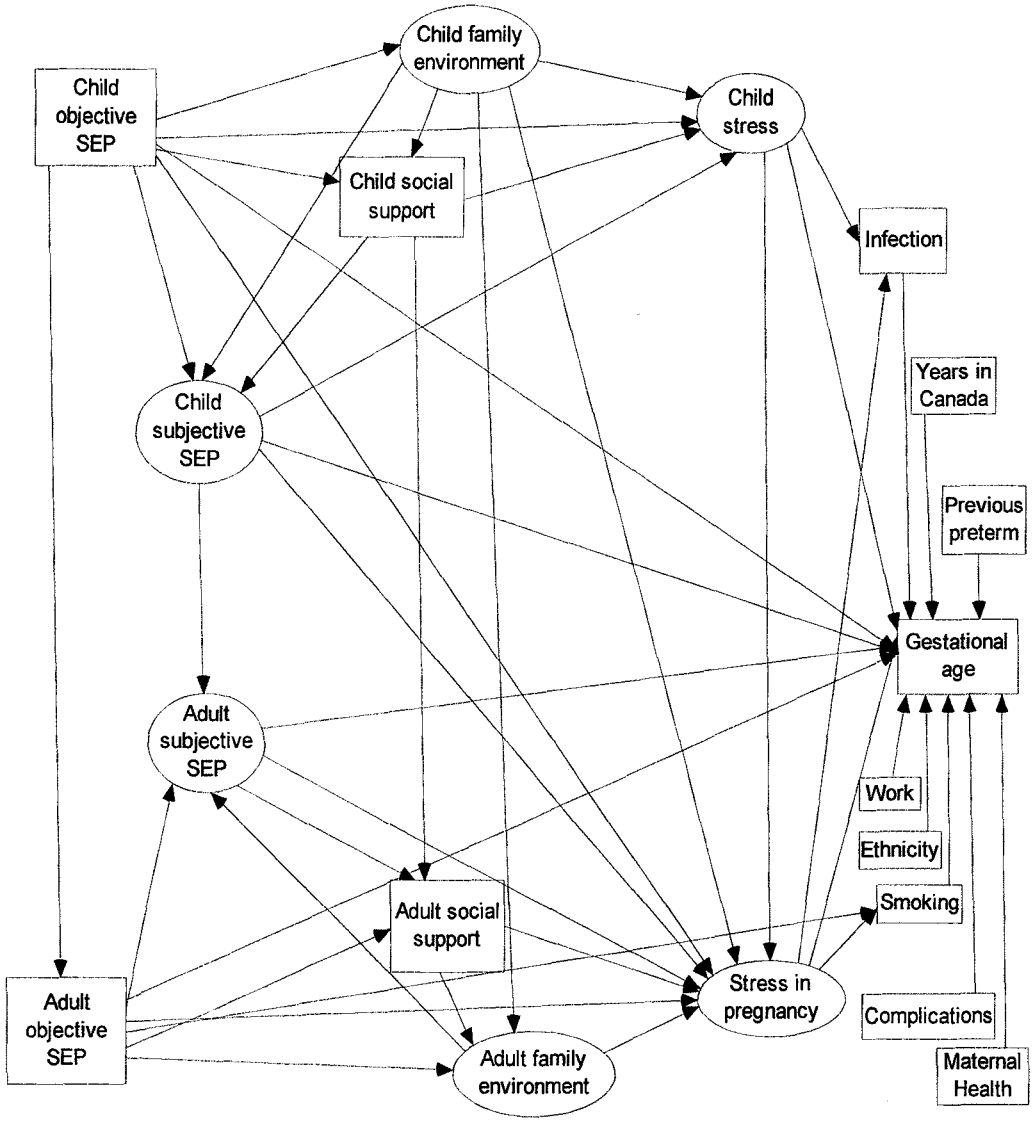
interventions that are delivered during pregnancy may be offered too late to be effective.

Based on the challenges associated with the delivery of early prenatal intervention, interest has grown in improving the preconception health of childbearing women (Atrash, Johnson, Adams, Cordero, & Howse, 2006; Misra, Guyer, & Allston, 2003). Life course theory encompasses the effects of both early and later life factors on adult health (Kuh & Ben-Shlomo, 2005). It is particularly beneficial for understanding the complex etiology of prenatal maternal stress and preterm birth in that it allows for the integration of behavioural, biological, psychosocial, and socioeconomic pathways that originate in both childhood and adulthood. As such, life course theory offers a useful framework for understanding preconception influences across a woman's life.

The Life Course Stress and Preterm Birth Model

Overview of model structure. The Life Course Stress and Preterm Birth Model builds on existing approaches by providing a theoretically-based model that uses a life course perspective as a basis for describing relationships between childhood and current adult influences on stress in pregnancy and preterm birth. The Life Course Stress and Preterm Birth Model (see Figure 1) depicts relationships between sources of stress in childhood and pregnancy, child and prenatal perceived stress, and preterm birth and is described fully in Chapter 2.

Figure 1. **Proposed Life Course Stress and Preterm Birth Model.**



Note. In diagrams of structural equation models, ovals represent unmeasured *latent variables* (e.g., stress in pregnancy, subjective SEP) and rectangles depict measured *indicator variables* (e.g., adult social support, ethnicity). Latent variables represent complex constructs that are difficult to measure. Numerous measured variables (i.e., indicators) are used to describe these constructs. To simplify the diagram, the indicators for each of the latent variables are not drawn in Figure 1, but are listed in Tables 4A and 4B.

The model is based on Lazarus and Folkman's (1984) transactional theory of stress. We distinguish stress from anxiety by noting that stress represents a process involving "a relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (Lazarus & Folkman, p. 21), whereas anxiety represents one of many potential responses to stress (Ridner, 2003). Family cohesion, social support, objective socioeconomic position (SEP), and subjective SEP in childhood and adulthood are conceptualized as both stressors (i.e., risk factors) and protective factors, as well as mediators through which an effect is carried forward to another variable (see Figure 1). As part of the model, we also specify how the constructs of child and adult family, subjective SEP, and perceived stress are defined in terms of relevant measurements.

Purpose

The purpose of this study was to test and refine the Life Course Stress and Preterm Birth Model. Using a prospective cohort design, we assessed the model by evaluating the fit of the proposed model to the sample data. Based on the empirical findings, modifications to the model are proposed and a final, "best-fit" model is presented.

The primary research question related to stress was:

> What pathways across a woman's life course lead to perceived stress in pregnancy?

The secondary research questions related to gestational age were:

a) What pathways across a woman's life course lead to preterm birth?

b) What are the contributions of behavioural (smoking, physical work), and biological (infection) factors to gestational age?

Hypotheses

With respect to stress, we hypothesized that: (a) pregnant women who perceived that they experienced high levels of stress during their childhood *or* adulthood as a result of their SEP or family environment were more likely to have high levels of perceived stress during pregnancy; (b) after controlling for adult stressors, childhood stressors and perceived stress in childhood were significantly and positively associated with stress in pregnancy; and (c) childhood perceived stress, and adult factors including family cohesion, subjective SEP, objective SEP, and social support mediated the relationships between childhood and adulthood SEP and family environment, and prenatal stress.

Secondary hypotheses were: (a) women with higher levels of perceived stress in childhood and/or adulthood were at greater risk for preterm birth; (b) childhood stress and stressors were independently and inversely associated with gestational age; and (c) the effect of SEP during childhood and/or in pregnancy on gestational age was mediated by

perceived stress and the family environment in childhood and family environment in adulthood and perceived stress in pregnancy.

Methods

Participants

Women were recruited consecutively from pre-birth clinics in two community-based hospitals in two centres in south-western Ontario between September, 2007 and March, 2008. Both hospitals serve a largely Caucasian population, are the only local centres with obstetric services in their communities, and have level II neonatal nurseries with annual deliveries of 1500 (site 1) and 4500 (site 2). Both sites are located in communities with higher household incomes and proportions of post-secondary educated residents and lower unemployment rates compared to similarly sized Ontario communities. Over 90% of women who plan to deliver at these centres attend the pre-birth clinics, typically between their 18^{th} and 24^{th} week of gestation. During the pre-birth clinic visit, a Registered Nurse meets individually with the pregnant woman to complete registration information for her labour and delivery admission and provide educational materials. Approval of this study was obtained from the Hamilton Health Sciences/McMaster University Faculty of Health Sciences Research Ethics Board (#07-035) (Appendix B) and the ethics committee that serves both hospitals (Appendix C).

Sampling and Recruitment

Women were eligible for this prospective cohort study if they: (a) were ≥16 years at the time of recruitment; (b) spoke/read English; and (c) were pregnant with a singleton infant. Women were excluded if they were not delivering their infant at the recruiting site. Two Registered Nurses in each pre-birth clinic who had received training on the participant recruitment and study procedures were responsible for asking each woman who met the inclusion criteria if she was interested in participating in the study. The nurses also obtained signed informed consent for participation (Appendix D).

Data Collection

A modified Dillman approach (Dillman, 2007) was used to survey pregnant women. After the women provided signed consent at their clinic visit, they were given a questionnaire to complete at home and mail back to the investigator in a self-addressed, pre-stamped envelope within 1 week. A follow-up thank-you/reminder letter was mailed to each participant at 1 week and reminder letters to women who had not returned the questionnaire were sent 3 and 6 weeks after the clinic visit, with a second questionnaire included in the 6 week mailing (Dillman). The prenatal questionnaire incorporated measurement instruments, and gathered sociodemographic and health-related information (Appendix E). Investigator-developed items were reviewed by content experts for face

and content validity. The questionnaire was reviewed by survey methodology experts and pilot-tested in 10 women who were 20 to 40 years of age to establish the clarity of the instructions and items, provide suggestions for alternate wording, and to identify items that needed to be added or removed. Recommendations from the pretesting process were incorporated into the final questionnaire. Other data related to gestational age were obtained through the Niday Database, Ontario's perinatal database. One research assistant coordinated questionnaire follow-up mailings, a second research assistant entered questionnaire data into the statistical database, and the primary investigator added secondary outcome data to the database. Processes were incorporated for verifying data entry.

Measurement of Model Variables

Perceived Stress

Global perceived stress in childhood. Global perceived stress during specific periods of childhood was measured using the 3-item Global Perceived Early Life Stress scale (GPELS) that assesses perception of overall stress during the preschool (age 0-5), pre-teen (age 6-12), and teen (age 13-16) years (Carpenter et al., 2004). The piloting of the prenatal questionnaire revealed that most women could not recall their level of stress during preschool years, and therefore this item was removed from the final questionnaire. Psychometric data for this tool were

not available (personal communication, L. Carpenter, November 25, 2006).

Because no existing measures of childhood perceived stress were available, a psychometrically evaluated measure of a related construct (i.e., anxiety) was included. The Screen for Child Anxiety Related Emotional Disorders (SCARED) instrument is a 41-item self-report questionnaire intended to screen for anxiety disorders in children (Birmaher et al., 1997; Birmaher et al., 1999). The 7-item Generalized Anxiety Disorder scale (GAD) of the SCARED was used. Sample items are "I am a worrier" and "I worry about other people liking me", and responses are arranged on a 3-point Likert scale with response options of *not true, somewhat true,* and *true* (Birmaher et al., 1997). This subscale has good internal consistency of .70 to .90 (Birmaher et al., 1999). Because the GAD was used retrospectively, items were modified to reflect past tense.

Global perceived stress in pregnancy. Global perceived stress in pregnancy was evaluated through the use of (a) investigator-developed global stress items (e.g., Overall, how much stress have you experienced *during the past year*?) with 5-point Likert scale responses ranging from *none* to *a great deal,* and (b) the Perceived Stress Scale (PSS) (Cohen, Kamarck, & Mermelstein, 1983). Respondents identify the frequency of experiences on a 5-point Likert scale ranging from *never* to *very often.*

Sample items include, "In the last month, how often have you felt nervous and stressed", and "In the last month, how often have you been upset because of something that happened unexpectedly" (Cohen & Williamson, 1988). The 10-item version has a Cronbach's alpha ranging from .78 to .93 (Cohen & Williamson). The PSS has been used in studies of pregnant women (Heaman, Blanchard, Gupton, Moffatt, & Currie, 2005; Kramer et al., 2009; Stancil, Hertz-Picciotto, Schramm, & Watt-Morse, 2000). Chronic stress was assessed by two investigator-developed items that asked women how stressful the past year and 3 years had been for them, offering ranges of responses from *extremely stressful* to *not at all stressful* on a 5-point Likert scale.

Perceived impact of socioeconomic and family stressors. The appraised impact of childhood socioeconomic and family environment stressors was evaluated retrospectively through an investigator-developed measure that followed each item related to socioeconomic and family circumstances (e.g., "How stressful was this situation for you as a child?"). Socioeconomic circumstances were related to wealth (e.g., home ownership), receipt of welfare benefits, change in financial situation (i.e., positive or negative), perception that the family did not have enough money for necessary and/or unnecessary things, perception that the family struggled financially, and overall sense of deprivation related to the family or financial situation. Stress related to the childhood and adult

family was each assessed by a single item asking about the overall amount of stress experienced because of family relationships or functioning. Perceived impact of stress related to current socioeconomic and family environment stressors was measured concurrently (e.g., "How stressful is this situation for you?") using the same items as those for childhood, but written in present tense. These questions used a 5-point Likert scale, ranging from *very stressful* to *not stressful at all.*

Gestational Age

Gestational age (number of completed weeks of gestation at delivery) was collected from the Niday Database. At each hospital site, designated staff enters pregnancy and labour/delivery information from the antenatal record, delivery record, and maternal and newborn hospital charts into this database. Each site's information is compiled in the provincial Niday Database.

Family Environment

Family environment in childhood was conceptualized in the model as a latent variable with six observed variables: four subscales of the Parental Bonding Inventory (PBI) (e.g., father care, father protection, mother care, mother protection); the cohesion subscale of the Family Adaptability and Cohesion Evaluation Scale III (FACES-III); and the General Functioning subscale of the McMaster Family Assessment Device (FAD). The 50-item PBI was used to assess the quality of parental

relationships during childhood. The PBI is intended for retrospective use (Parker, 1989; Parker, 1990). The two-part tool asks participants to respond to statements as they remember their mother (25-items) and father (25-items) during their first 16 years of life (Parker, 1989). Sample items are "Spoke to me in a warm and friendly voice" and "Tried to control everything I did" (Parker). Responses range from *very like* to *very unlike* (e.g., is the statement very like your mother) on a 4-point Likert scale. As recommended, a "father-figure" or "mother-figure" was the referent for those without fathers or mothers (Parker, 1990). Reliability of the care scales is .91 - .93 and for the protection scales it is .87 - .88 (Richman & Flaherty, 1986).

The FACES-III cohesion subscale was used to evaluate cohesion in the childhood and adult family. Using responses ranging from *strongly disagree* to *agree* on a 5-point Likert scale, respondents answer questions such as "Family members ask each other for help", and "Family members feel very close". This instrument was used retrospectively for the childhood family, where items were slightly changed to reflect past tense, and concurrently for the adult family. The 10-item cohesion subscale has an internal consistency of .77 (Neabel, Fothergill-Bourbonnais, & Dunning, 2000). The 12-item General Functioning Subscale of the FAD was used to assess family functioning of the woman's current and childhood family. It includes problem solving, communication, roles, affective responsiveness,

affective involvement, and behaviour control (Neabel et al.). Sample items are "In times of crisis we can turn to each other for support" and "We cannot talk to each other about the sadness we feel". Responses range from *strongly agree to strongly disagree* on a 4-point Likert scale (Byles, Byrne, Boyle, & Offord, 1988). This subscale has been found to have good internal consistency (Cronbach's α = .86) and construct validity (Byles et al.).

Socioeconomic Position (SEP)

Objective SEP. Child and adult objective SEP were represented by separate indices created by summing weighted items related to the childhood family or current family. All scores were converted from their original scaling to a score out of 8, the highest number of response categories among the items in the index. Converted scores were then summed together so that each of the original scales contributed equally to the weighted index. Specific questions that comprised the indices were related to (a) average household social class based on the average of the National Statistics Socioeconomic Classification (NS-SEC) for mother/father for the childhood index and own/partner for the current social class, (b) average household education based on the average father/mother education for childhood index and own/partner education for adult index, (c) wealth (ownership of house during childhood and at

present), and (d) household income of current household (in adult index only).

Subjective SEP. Adult and child subjective SEP were each conceptualized as a latent variable with six indicators. Subjective social status was measured using the MacArthur Scales of Subjective Social Status. Using an image of a ladder, participants placed a single "x" on one of the 10 rungs of the community ladder representing where they believe they stood in their community. Perception of social standing on this ladder encompasses a sense of personal importance in the community (Singh-Manoux, Adler, & Marmot, 2003). A second ladder, the SES ladder, asked respondents to rank themselves based on their occupation, education, and income compared to others in their country (Singh-Manoux et al.). This ladder reflects more traditional aspects of SEP. In a study of adolescents, reliability of the SES ladder was .73 and .79 for the community ladder (Goodman et al., 2001). No specific reliability estimates have been reported for adults. Although one study has used this tool retrospectively (Gianaros et al., 2008), it has not been psychometrically evaluated retrospectively. The participant instructions for this instrument were modified slightly to instruct respondents to mark the social status of their family when they were children, and their current status as adults. Other investigator-developed items assessing subjective social status were related to the perception of economic adversity: perception of

duration of adversity; degree of adversity (e.g., perception of having enough money for necessary and unnecessary things, a global measure of perceived deprivation); and perceived impact of changes in financial circumstances. Questions were asked in relation to both the period of childhood and the present time.

Social Support

The 60-item Child and Adolescent Social Support Scale (CASSS) is a relatively new instrument that measures childhood perceived social support using subscales related to parental, teacher, classmate, and close friend support (Malecki & Demaray, 2002). Sample items are "My teachers cared about me" and "My close friend(s) understood my feelings". Because items in the parental subscale are similar to those in the selected family instruments, this subscale was not used. Coefficient alpha of the total scale is high in both elementary (.96 - . 97) and high school (.97) students (Demaray & Malecki, 2002). Given the retrospective use of this instrument, items were amended to reflect the past tense.

Perceived social support during adulthood was measured using the 12-item version of the Interpersonal Support Evaluation List (ISEL-12) (Cohen, Mermelstein, Kamarck, & Hoberman, 1985). The ISEL-12 evaluates tangible assistance or material aid, appraisal of support or the availability of a confidant, and belonging support or the availability of another for fun/relaxation (Cohen et al.). Participants respond to items

using a 4-item Likert-type scale from *definitely false* to *definitely true.* Sample items include: "I feel that there is no one I can share my most private worries and fears with" and "I don't often get invited to do things with others" (Cohen et al.). Cronbach's alpha is .81 in adults (Cohen et al.).

Other Risk Factors for Preterm Birth

Using investigator-developed items, women were asked whether they had ever had a premature baby, to self-report their ethnicity from a structured list, whether they considered their daily work routine as physically demanding (yes/no), and how many cigarettes they smoke per day currently and just before they became pregnant. Maternal health conditions and any complications experienced during pregnancy, labour, and/or delivery were obtained from the Niday Database. For inclusion in the model, the number of maternal health conditions was summed, as well as the number of complications experienced (see Figure 1).

Other Risk Factors for Prenatal Stress

Three additional potential risk factors for prenatal stress were self-reported: number of weeks gestation, parity, and age. Number of weeks gestation at the time of questionnaire completion was assessed because previous studies have demonstrated that maternal stress is attenuated with advancing gestation (Glynn et al., 2001). Parity and maternal age

were also determined because we expected that they may impact perceived maternal stress.

Data Analysis

Overview of Structural Equation Modeling (SEM)

Structural equation modeling is a "family" of statistical analyses that relies upon the *a priori* development of a model describing causal relationships between variables (Kline, 2005). It allows the simultaneous estimation of both direct and indirect hypothesized relationships using regression coefficients while adjusting for other factors in the model (Kline). Structural equation modeling is particularly useful for exploring the complex etiology of preterm birth because it allows the testing of multiple theoretical pathways. It is also beneficial for studying early life influences on later adult outcomes in that it permits the inclusion of both early life and adult variables in the same model for analysis.

Sample Size

Sample size calculation for SEM depends upon a number of factors, including size and complexity of the model, psychometric properties of the measures, strength of the relationships among the variables, and normality of the data (Raykov & Marcoulides, 2006). Raykov and Marcoulides indicate that "no easily applicable and clear-cut general rules of thumb [for sample size] have been proposed" (p. 30) that consider these varying aspects. However, Kline (2005) suggests that over

200 cases should be considered for complex models. Based on these considerations, sample sizes of existing studies of stress and preterm birth using SEM, and non-participation and loss to follow-up rates from studies of maternal health conducted by research team members (WS, PK), we calculated a final sample size of 470 women allowing an additional 30% to offset non-participants and dropouts.

Procedure

We tested the assumption of multivariate normality by assessing univariate distributions using histograms and bivariate relationships using bivariate scatterplots, reviewing skew statistics based on established guidelines whereby an absolute value of the kurtosis index <10 suggests normality, and by assessing distributions for outliers (Kline, 2005). We used a two-step modeling procedure for our analysis as recommended by Kline. First, we analyzed and refined the fit of the measurement components of the model. Once the measurement components were admissible and well-fitting, we analyzed the fit of the model as a whole.

Multiple model fit indices were used to assess model fit (Kline, 2005), including the model chi-square, the Steiger-Lind root mean square error of approximation and its 90% confidence interval (RMSEA) (Steiger, 1990), and the Bentler comparative fit index (CFI) (Bentler, 1990). We used maximum likelihood estimation for estimation of means, variances, and covariances of the variables in order to retain records with missing

data in our analysis. Maximum likelihood estimation is a preferred estimation method because it offers a more efficient and consistent approach with less bias in handling *missing-at-random* data than pairwise or listwise deletion, or single imputation (Byrne, 2001).

Modifications to the model were guided by the theoretical plausibility of the pathway and model fit statistics (Kline, 2005), and involved the addition or restructuring of pathways as well as the addition of error covariances. Given that fit indices are indicators of the overall fit of the model (Kline), the fit of specific parts of the model was judged by the size of the error variances. Statistically non-significant pathways ($p < .05$) were removed from the final model to promote parsimony if the model fit was not adversely affected by their deletion.

We used a four-step process to assess variables for mediation involving the evaluation of the level of statistical significance of the relationships between the independent and dependent variable, the independent variable and the mediator, the mediator and the dependent variable while controlling for the independent variable (Baron & Kenny, 1986), and the indirect pathway as a whole. The Sobel test was used to evaluate the level of statistical significance of the indirect, mediated pathway (Preacher & Leonardelli, 2006). Mediational relationships were assessed independent of the whole model. All analyses were conducted using SPSS (16.0) and AMOS (16.0).

Results

The Sample

The final sample comprised 441 women, 263 from site 1 and 178 from site 2. Participation rate was 68.2% at site 1 and 44.0% at site 2 for an overall study participation rate of 56.4% (639/1133). The questionnaire return rate was 74% (472/639). Of these, 12 women were excluded because their questionnaires were returned post-delivery; one of these women also delivered twins. Our final analysis was based on women for whom outcome data were available (N = 441) with a loss to follow-up rate of 4.1%.

Sample characteristics are displayed in Tables 1 through 4. The mean age of women in our sample was 29.8 years (SD = 5.8) and the mean gestational age at the time of questionnaire completion was 28.2 weeks (SD = 5.3), ranging from 13 to 40 weeks. The majority of women were married or living common-law, had attended community college or university, and were born in Canada. Almost half of the women had household incomes greater than CAN $80,000 and the mean MacArthur ladder ratings were slightly higher than those reported in the only other study of pregnant women (Adler, 2000).

Table 1: *Sociodemographic and Family Characteristics of Sample (N = 441)*

Characteristic	*M (SD)*	*n (%)*	
Maternal age (years)	29.8 (5.8)		
Primiparity		190	(43.1)
Marital status			
Married/Common-law		420	(95.2)
Single/Separated		21	(4.8)
Born in Canada		365	(83.0)
Maternal education			
High school or less		80	(18.1)
Some or completed community college		160	(36.4)
Some or completed bachelor's degree		143	(32.5)
Graduate degree		57	(13.0)
Income			
<$10,000		8	(1.9)
$10,000 – $19,999		14	(3.3)
$20,000 – $39,999		61	(14.3)
$40,000 - $59,999		63	(14.7)
$60,000 - $79,999		70	(16.4)
≥$80,000		212	(49.5)
Child family community ladder	6.6 (1.7)		
Child family SEP ladder	6.2 (1.7)		
Adult community ladder	6.5 (1.5)		
Adult SEP ladder	6.4 (1.6)		
Child FACES III	36.2 (7.9)		
Adult FACES III	42.3 (5.8)		

Note. ***M*** **= mean.** ***SD*** **= standard deviation.** ***n*** **= number of respondents.**

Table 2: *Obstetric Risk Factors and Delivery Characteristics of Sample* (*N* = 441)

Characteristic	*M (SD)*	*n (%)*
Preterm birth risk factors		
Had previous preterm delivery		33 (7.5)
Smoked before or during pregnancy		79 (17.9)
Physically demanding work		140 (31.7)
Delivery <37 weeks		19 (4.6)
Gestational age at questionnaire completion (weeks)	28.2 (5.3)	
Gestational age at delivery (weeks)	39.2 (1.5)	
Birth weight (grams)	3489 (487)	
Delivery mode		
Vaginal		297 (71.4)
Caesarean section		119 (28.6)

Note. ***M*** **= mean.** ***SD*** **= standard deviation.** ***n*** **= number of respondents.**

Table 3: *Childhood Psychosocial Characteristics of Sample* (*N* = 441)

Characteristic	*n*	(%)
Child stress in elementary school		
Essentially stress free	116	(26.4)
Less stressful than most kids my age	106	(24.1)
About average	147	(33.5)
More stressful than most kids my age	54	(12.3)
Extremely stressful	16	(3.6)
Child stress in teen years		
Essentially stress free	47	(10.7)
Less stressful than most kids my age	108	(24.7)
About average	159	(36.2)
More stressful than most kids my age	100	(22.8)
Extremely stressful	25	(5.7)
Overall stress in childhood		
Extremely stressful	10	(2.3)
Very stressful	36	(8.2)
Moderately stressful	108	(24.6)
Mildly stressful	200	(45.6)
Not at all stressful	85	(19.4)
Child family stress		
Extremely stressful	14	(3.2)
Very stressful	40	(9.2)
Moderately stressful	86	(19.8)
Mildly stressful	158	(36.3)
Not at all stressful	137	(31.5)
Child financial stress[a]		
Extremely stressful	3	(1.3)
Very stressful	24	(10.4)
Moderately stressful	56	(24.2)
Mildly stressful	110	(47.6)
Not at all stressful	38	(8.6)

Note. ***n*** **= number of respondents.**

[a]Question was asked of respondents who reported that their family experienced financial stress (*n* = 231)

Table 4: *Adulthood Psychosocial Characteristics of Sample (N = 441)*

Characteristic	*M (SD)*	*n (%)*
Adult Perceived Stress Scale	17.0 (3.9)	
Adult overall how stressful past month		
Extremely stressful		7 (1.6)
Very stressful		46 (10.5)
Moderately stressful		115 (26.1)
Mildly stressful		209 (47.5)
Not at all stressful		63 (14.3)
Adult overall how stressful past year		
Extremely stressful		14 (3.2)
Very stressful		40 (9.1)
Moderately stressful		140 (31.8)
Mildly stressful		204 (46.4)
Not at all stressful		42 (9.5)
Adult overall how stressful past 3 years		
Extremely stressful		7 (1.6)
Very stressful		48 (10.9)
Moderately stressful		154 (35.0)
Mildly stressful		196 (44.5)
Not at all stressful		35 (8.0)
Adult family stress		
Extremely stressful		4 (1.0)
Very stressful		10 (2.3)
Moderately stressful		40 (9.2)
Mildly stressful		178 (40.9)
Not at all stressful		203 (46.0)
Adult financial stress[a]		
Extremely stressful		15 (5.9)
Very stressful		29 (11.4)
Moderately stressful		78 (30.6)
Mildly stressful		114 (44.7)
Not at all stressful		19 (7.5)
Adult ISEL	42.0 (5.3)	

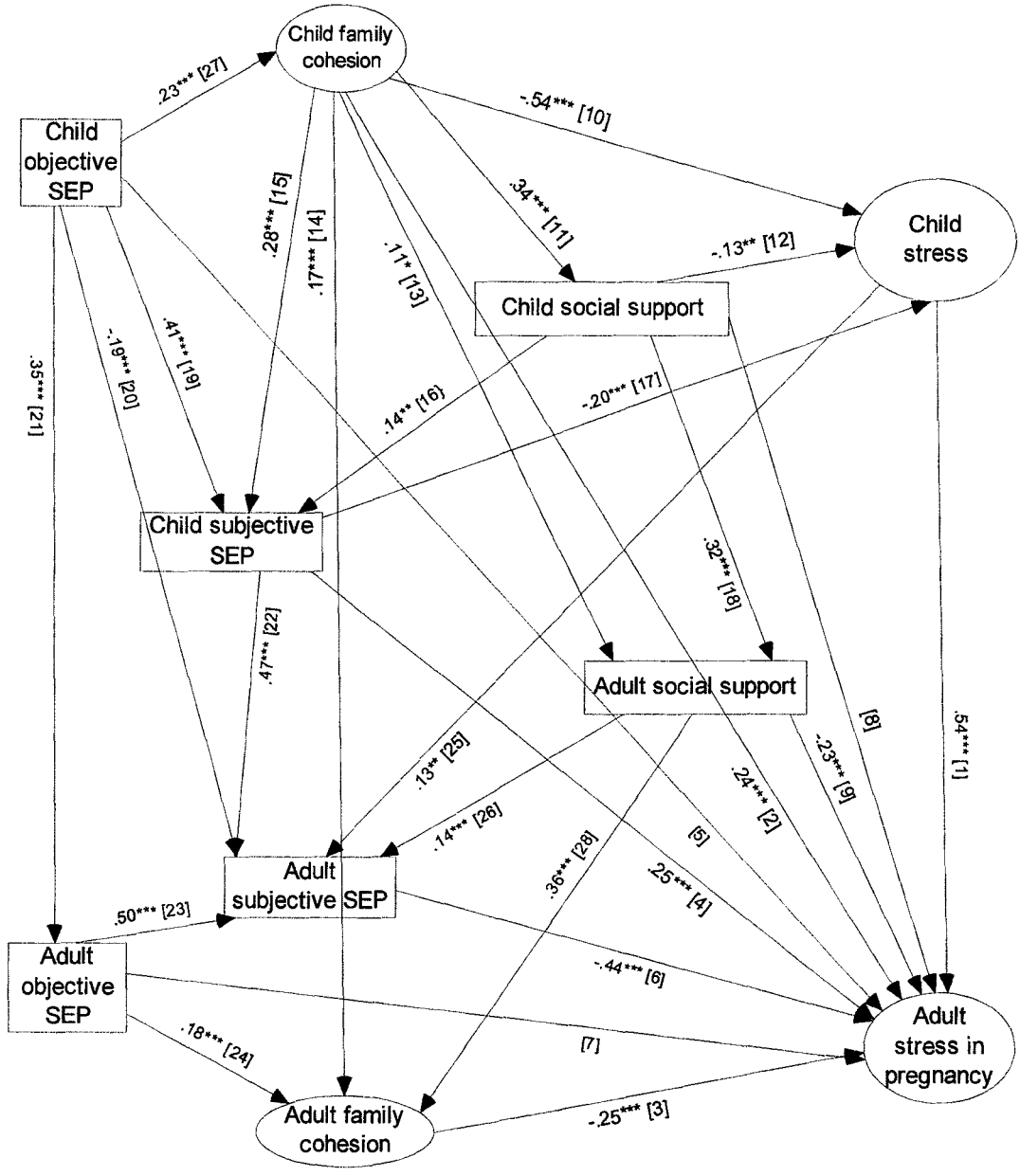
Note. M = sample mean; SD = standard deviation; n = number of respondents by characteristic.
[a]Question was asked of respondents who reported that their family experienced financial stress (*n* = 255)

A vast majority of women's parents were married (85.9%). Almost half of the fathers (46.0%) and mothers (48.2%) had some post-secondary education. Sixteen percent of women reported that their elementary years were more or extremely more stressful than others their age, while 28.5% reported similar levels of stress during their teen years. More than one-third of the sample (35.1%) reported that their childhood was overall moderately to extremely stressful. The correlations between overall childhood stress and stress related to SEP (r = .65) and family cohesion (r = .77) are similar. Almost half (47.5%) of the women reported scores of "recalled" childhood anxiety above the screening cutoff of 9 on the GAD, suggesting increased risk of Generalized Anxiety Disorder. Considering their current circumstances, 44.1% of women indicated that they experienced moderate to extreme levels of stress during the past year, and 47.5% reported similar levels of stress over the previous three years. Less than 5% (n = 19) of women in our sample delivered preterm infants (<37 weeks gestation) precluding reliable estimation of pathway coefficients in the model.

Overall Changes to Proposed Model

The final model is shown in Figure 2. Tables 5 and 6 display the standardized factor loadings and associated confidence intervals for the measurement components of the final model. As expected, step one of our SEM analysis resulted in modification of the measurement components of the model. Changes to the child and adult family environment latent variable included (a) deletion of the McMaster Family Assessment Device due to statistically non-significant factor loadings (child r = .06; adult r = .10) and (b) deletion of the PBI subscales to improve model fit. The final child and adult family models comprised the scale items of the FACES-III cohesion subscale. The only change to the child and pregnancy stress latent variables was the addition of the deprivation variable as an indicator on each (removed from subjective SEP), which greatly improved the fit of the stress measurement model.

Figure 2. **Final Life Course Stress Model.**



Note. Standardized pathway coefficients are reported. Pathway numbers are in square brackets following the coefficient. Pathways 5, 7, and 8 are non-significant and are included only to aid discussion of mediators; they are not part of the final model. ***$p < .001$. **$p < .01$. *$p < .05$.

Table 5: ***Factor Loadings of Family Cohesion Measurement Components (Final Model)***

Latent Variable	Indicator	Standardized Factor Loading (95% Confidence Interval)
Childhood Family Cohesion[a]	Family members asked each other for help	.70 (.65 - .75)
	We approved of each other's friends	.57 (.50 - .64)
	We liked to do things with just family.	.75 (.71 - .79)
	Family members felt closer to family than others	.70 (.65 - .75)
	Family members spent free time together	.79 (.76 - .83)
	Family members felt very close	.85 (.83 - .88)
	When family got together, everyone was present	.69 (.64 - .74)
	We could easily think of things to do as a family	.86 (.83 - .89)
	Family members consulted other family members on their decisions	.73 (.69 - .78)
	Family togetherness was important	.86 (.83 - .89)
Adult Family Cohesion[a]	Family members ask each other for help	.66 (.61 - .72)
	We approve of each other's friends	.56 (.50 - .63)
	We like to do things with just family	.69 (.64 - .74)
	Family members feel closer to family than others	.59 (.53 - .65)
	Family members spend free time together	.80 (.76 - .84)
	Family members feel very close	.89 (.88 - .91)
	When family gets together, everyone is present	.74 (.70 - .78)
	We can easily think of things to do as a family	.73 (.69 - .78)
	Family members consult other family members on their decisions	.75 (.71 - .79)
	Family togetherness is important	.74 (.70 - .78)

Note. All factor loadings are statistically significant at the $p < .001$ level. [a]FACES III Cohesion Subscale

Table 6: ***Factor Loadings of Stress Measurement Components (Final Model)***

Latent Variable	Indicator	Standardized Factor Loading (95% Confidence Interval)
Childhood Stress	Deprivation	.71 (.67 - .76)
	SCARED (Total score)	.53 (.46 - .60)
	Family stress	.84 (.82 - .87)
	Overall stress	.91 (.90 - .93)
	Stress in elementary years	.73 (.69 - .78)
	Stress in teen years	.74 (.70 - .78)
	Financial stress	.71 (.67 - .76)
Stress in Pregnancy	Deprivation	.67 (.62 - .72)
	PSS (Total score)	.69 (.64 - .74)
	Family stress	.58 (.52 - .65)
	Stress past month	.65 (.60 - .71)
	Stress past year	.67 (.62 - .72)
	Stress past 3 years	.57 (.50 - .64)
	Financial stress	.75 (.71 - .79)

Note. All factor loadings are statistically significant at the $p < .001$ level.

The adult and child subjective SEP measurement model was the most challenging to fit. In step one, the model achieved excellent fit statistics with the addition of theoretically plausible error covariances. However, the addition of the measurement portion to the overall model produced an ill fit, which could not be rectified with further changes to the measurement part. In order to improve fit of the overall model, we constructed a child and adult subjective SEP index as follows. Based on an examination of the pathway coefficients of the SEP measurement portion and the face validity of each of the indicators, we summed the MacArthur community and SES ladder values to obtain one subjective SEP index for childhood and a second for adulthood. Finally, all statistically non-significant pathways ($p < .05$) were removed from the model, which included all paths leading to infection and gestational age.

Model statistics indicated that the final model adequately fit the data (CFI = .93; RMSEA = .048). The model chi-square value was statistically significant, X^2 (706, N = 441) = 1407.5, $p < .001$, suggesting that there were significant differences between observed and implied covariance matrices of the model. However, this is not unusual for large, complex models (Kline, 2005). To compensate for a large sample size, we calculated the normed chi-square (NC) by dividing the chi-square value by its degrees of freedom (X^2/df) to obtain an NC of 2.0 (Kline). Bollen (1989) suggests that NC values < 5.0 indicate reasonable fit.

Primary Outcome

The implied correlation matrix is found in Appendix F. Table 7 displays mediators for each direct pathway to adult stress that was retained in the final model. We distinguish between the child and adult factors by labeling them as such, but emphasize that "adult" refers to pregnant women. Results are presented by research question. All pathway estimates (β) are reported in standardized format. Pathway estimates and associated significance levels are noted on Figure 2.

Research Question 1: Pathways that lead to perceived stress in pregnancy

Impact of childhood stress on stress in pregnancy [1]. As hypothesized, childhood stress had a statistically significant, positive impact on stress in pregnancy (β = .54), even after adjustment for other child and adult factors (see Figure 2). Adult subjective SEP and adult family cohesion partially mediated this relationship through much smaller, indirect pathways suggesting that the impact of childhood stress on adult stress may, to a smaller degree, be due to these variables (Table 7). These mediated pathways revealed that childhood stress was significantly inversely related to adult family cohesion (β = -.20) and subjective SEP (β = -.17), which were then negatively associated with prenatal stress.

Table 7: ***Mediators of Direct Pathways in Final Model***

Final Model Pathway [Pathway number]	Mediator	Pathway coefficients (standardized)	Sobel test[a]
Child stress → stress in pregnancy [1]	Adult family cohesion	Indirect: 0.08*** Direct: 0.35***	3.348
	Adult subjective SEP	Indirect: 0.07** Direct: 0.36 ***	3.109
Child family cohesion → stress in pregnancy [2]	Child stress	Indirect: -0.35*** Direct: 0.14†	-5.655
	Adult family cohesion	Indirect: -0.12 *** Direct: -0.10†	-4.263
	Adult subjective SEP	Indirect: -0.08** Direct: -0.14 **	-3.243
Adult family cohesion → stress in pregnancy [3]	Adult subjective SEP	Indirect: -0.10*** Direct: -0.35 ***	-4.060
Childhood subjective SEP → stress in pregnancy [4]	Child stress	Indirect: -0.20*** Direct: 0.03 (NS)	-5.423
	Adult subjective SEP	Indirect: -0.22*** Direct: 0.04 (NS)	-6.471
Childhood objective SEP → stress in pregnancy [5]	Note: Analysis of indirect (unmediated) paths revealed significant indirect pathways from childhood objective SEP to adult stress through adult objective SEP (r = -.10; p < .001), adult subjective SEP (r = -.08; p < .01), and child subjective SEP (r = -.08; p = .001). Childhood objective SEP had a positive effect on childhood subjective SEP (r = .49) and adult objective SEP (r = .51), and a small effect on adult subjective SEP (r = .16).		
Adult objective SEP → stress in pregnancy [b] [7]	Adult family cohesion	Indirect: -0.10*** Direct: -0.21***	-3.796
	Adult social support	Indirect: -0.05** Direct: -0.26***	-2.557
	Adult subjective SEP	Indirect: -0.23*** Direct: -.09 (NS)	-6.192
Child social support → stress in pregnancy [8]	Child stress	Indirect: -0.14 *** Direct: -0.14**	-3.932
	Adult social support	Indirect: -0.14*** Direct:-0.14*	-5.209
Adult social support→ stress in pregnancy [9]	Adult family cohesion	Indirect:-0.14*** Direct: -0.32***	-4.636
	Adult subjective SEP	Indirect: -0.13 *** Direct: -0.32***	-4.678

Note. Pathway numbers correspond to those in the text and Figure 2. The pathway adult subjective SEP – stress in pregnancy [6] did not have any mediators to test. [a]A Sobel statistic of < - 1.96 and > 1.96 is statistically significant. [b] Post-hoc analysis with adult subjective SEP-adult stress pathway removed revealed that adult objective SEP had a statistically significant effect on stress (r = -.24, p < .001). Removing childhood subjective SEP did not alter the magnitude of the adult objective SEP-stress pathway, or the total proportion of variance of stress in pregnancy.

Impact of childhood family cohesion on stress in pregnancy [2].

Childhood family cohesion had a small, statistically significant positive impact on stress in pregnancy (β = .24). This relationship was partially mediated by childhood stress, adult family cohesion, and adult subjective SEP. For each mediator, the overall indirect path was negative, suggesting that the indirect effect of child family cohesion through these variables resulted in a decrease in prenatal stress (Table 7). For child stress and adult cohesion, the direct effect of child family cohesion on prenatal stress became non-significant in the presence of each mediator, indicating that the indirect, mediated pathway was a more important contributor to stress in pregnancy than the direct pathway. However, both the direct and indirect paths remained statistically significant for subjective SEP. When we decomposed this mediated relationship, we found a significant, positive relationship between child family cohesion and adult subjective SEP (β = .17), and a larger, negative effect between subjective SEP and prenatal stress (β = -.47).

We assessed whether suppression was responsible for producing a positive pathway coefficient between child family cohesion and stress in pregnancy. Suppression occurs when the magnitude of the relationship between a dependent and independent variable becomes larger in the presence of a third, controlling variable, or the direct and indirect pathways of a mediation model have different signs (MacKinnon, Krull, & Lockwood,

2000). We concluded that the direct pathway was suppressed in the mediated model because (a) the indirect pathway from child family cohesion to prenatal stress through child stress was negative, whereas the direct pathway was positive, (b) the magnitude of the indirect path was larger than the direct path (indirect β = -0.29; direct β = 0.24), and (c) the unmediated direct pathway was smaller and negative (β = -.06). The implication of the suppression of the child family cohesion – prenatal stress pathway is that under typical circumstances, high child family cohesion results in reduced prenatal stress. However, in the unique and unlikely circumstance where child family cohesion reduces childhood stress, but this lower childhood stress results in an unexpected elevated prenatal stress, then the child family – prenatal stress pathway would appear positive.

Impact of adult family cohesion on stress in pregnancy [3]. Adult family cohesion had a small, statistically significant negative impact on prenatal stress (β = -.25). Adult subjective SEP mediated this relationship, although the direct pathway was three times larger in magnitude than the indirect (Table 7).

Impact of childhood subjective SEP on stress in pregnancy [4]. Childhood subjective SEP had a small, statistically significant positive impact on prenatal stress (β = .25). Adult subjective SEP and child stress were strong mediators of this relationship, and the magnitude of the direct

pathway was reduced to statistical non-significance in the presence of the mediator (Table 7). This pattern suggests that the influence of childhood subjective SEP on stress in pregnancy was almost wholly due to the indirect effects of adult subjective SEP and childhood stress.

Impact of childhood objective SEP on stress in pregnancy [5]. The main, direct effect of childhood objective SEP on prenatal stress was non-significant in both the final model and when tested for mediation. Although the main pathway did not meet criteria for mediation testing, we evaluated indirect pathways to assess whether childhood objective SEP acted indirectly (unmediated) on prenatal stress through other socioeconomic variables. We found that childhood objective SEP reduced prenatal stress indirectly by increasing adult objective SEP, adult subjective SEP, and, to a smaller degree, childhood subjective SEP (Table 7). In the model, childhood objective SEP had large, positive effects on adult objective and childhood subjective SEP (see Figure 1).

Impact of adult subjective SEP on stress in pregnancy [6]. Adult subjective SEP had a moderate, significant negative effect on prenatal stress (β = -.44). There were no mediated pathways to test.

Impact of adult objective SEP on stress in pregnancy [7]. In the final model, adult objective SEP had a non-significant effect on prenatal stress (i.e., when controlled for by adult subjective SEP). When tested for mediation, the direct pathway had a significant, negative effect on adult

stress in the presence of three mediating adult variables: family cohesion, social support, and subjective SEP (Table 7). When family cohesion and social support were introduced as mediators, the direct path between objective SEP and prenatal stress remained statistically significant and larger in magnitude than the indirect paths, suggesting that the effect was largely direct. However, when subjective SEP was added as a mediator, the direct effect became small and non-significant, indicating that most of the influence of objective SEP on prenatal stress was due to subjective SEP.

Impact of child social support on stress in pregnancy [8]. In the final model, the effect of child social support on prenatal stress was non-significant, but was significant in the mediational analyses with indirect paths including childhood stress and adult social support. For both mediators, the direct path remained statistically significant and was similar in magnitude to the indirect path (Table 7), suggesting that the direct and indirect paths represent small but equally important influences on prenatal stress. In the main model, the pathway between childhood social support and adult support was statistically significant (see Figure 2).

Impact of adult social support on stress in pregnancy [9]. After accounting for family and socioeconomic protective factors, adult social support had a small, statistically significant negative effect on prenatal stress (β = - .23). This relationship was mediated by both adult family

cohesion and subjective SEP. For both mediators, the direct pathway remained statistically significant and larger in magnitude than the indirect pathways (Table 7). The magnitudes of the direct and indirect pathway coefficients were similar for each mediator. These findings suggest that most of the effect of social support on prenatal stress was direct.

Potential confounder analysis. Potential confounders were assessed in the final model by including direct paths to prenatal stress for parity, marital status, maternal age, weeks gestation at the time of survey completion, ethnicity, and whether born in Canada or not (data not shown). All paths were statistically non-significant and did not improve model fit. All confounders explained only 3% of the variance in prenatal stress. These findings suggest that the effect of these variables on prenatal stress after taking into account all other pathways was negligible. Consequently, these paths were removed from the final model.

Discussion

To our knowledge, no other studies have explored the impact of childhood factors on stress in pregnancy and research on adult factors is very limited. Our study therefore contributes to the small body of existing literature on predictors of stress in pregnancy, and provides new evidence regarding the effects of early life stress on prenatal maternal stress. In addition, few studies have compared the effects of objective and subjective SEP (Singh-Manoux et al., 2003), and we know of only one

other study has explored predictors of childhood SEP (Goodman, McEwen, Dolan, Schafer-Kalkhoff, & Adler, 2005).

As hypothesized, recalled childhood stress had an independent, enduring effect on prenatal maternal stress. The persistence of perceived stress across the life course is concerning because it may be linked to stress dysregulation processes that can result in long-term poor psychological and physical health outcomes (McEwen, 2007). One recent study found an association between childhood stress and physiologic stress dysregulation in pregnant women at 12 to 24 weeks gestation (Shea et al., 2007). Although the mechanisms underlying the transmission of childhood stress to prenatal stress are unclear, a number of possibilities have been proposed (Appendix G). These mechanisms may also provide insight into how adult family cohesion and subjective SEP mediate the childhood stress-prenatal stress relationship. Specifically, the consequences of child stress during critical, formative years may comprise (a) impaired coping mechanisms that persist into adulthood and affect family relationships and circumstances, or (b) faulty perceptions that lead women who experienced high childhood stress to also perceive that they have lower family cohesion or subjective SEP as adults. Past studies have found that children exposed to chronic stress may not be able to accurately appraise stressors as challenging or threatening (Olff. Langeland, & Gersons, 2005), and have a greater tendency to see the

world as a threatening place (Luecken & Lemery, 2004; Chen and Matthews, 2003; Chen, Langer, Raphaelson, & Matthews, 2004).

We found that childhood family cohesion represented an important protective factor that had enduring effects into adulthood. This finding is consistent with physiologic studies that demonstrated the impact of a cohesive childhood family on the reduction of maladaptive stress responses in adults (Lueckens, Rodriguez, & Appenhans, 2005); however, our analysis indicates that this effect is largely indirect by reducing stress in childhood and promoting adult family cohesion. Family relationships contribute to the psychological health of a child through a number of well-studied processes (Appendix H), although threat appraisal appears to be the main mediator between poor family relationships and childhood stress (Davies et al., 2002; Lengua, Sandler, West, Wolchik, & Curran, 1999).

The influence of childhood family cohesion on current family patterns is supported by studies that found that childhood family discord and conflict have enduring effects on adult psychological health (Kuh, Hardy, Rodgers, & Wadsworth, 2002). Negative interpersonal processes and family communication patterns developed within the childhood family (Whitton, Rhoades, Stanley, & Markman, 2008; Huurre, Junkkari, & Aro, 2006) or the intergenerational transmission of parenting practices (Belsky, Jaffee, Hsieh, & Silva, 2001; Capaldi, Pears, Kerr, & Owen, 2008) may be vehicles through which the childhood family influences the adult family.

In our study, low adult family cohesion was one of the main contributors to stress in pregnancy. Given that our sample was comprised of childbearing women, a major consideration in judging family cohesion was likely to be the spousal/partner relationship. Partner relationship concerns are significantly related to increased perceived stress and elevated markers of physiologic stress in non-pregnant (Ditzen, Hoppmann, & Klumb, 2008; Robles & Kiecolt-Glaser, 2003) and pregnant women (Stancil et al., 2000).

We hypothesized that high subjective SEP in childhood would reduce stress in pregnancy and suggested that suppression of this pathway resulted in its positive relationship in the main model (MacKinnon, Krull, & Lockwood, 2000). The primary role that childhood subjective SEP plays in prenatal stress is to reduce childhood stress and increase adult subjective SEP. Other studies found that low perceived SES was associated with higher levels of perceived stress (Goodman et al., 2005), greater threat interpretations, and increased stress reactivity (Chen et al., 2004). The positive effect of childhood subjective SEP on adult subjective SEP (even when controlled for adult objective SEP) suggests that the formation of a subjective sense of SEP during the critical period of childhood persists into adulthood.

Our findings are consistent with others who observed that childhood objective SEP plays an indirect role on adult psychological

health by influencing adult objective SEP and related life opportunities (Sacker, Schoon, & Bartley, 2002). We also found that childhood objective SEP plays an important role in increasing childhood subjective SEP and, to a lesser degree, adult subjective SEP. The negative association between adult subjective SEP and prenatal stress is consistent with other studies that, using the same measure, found that subjective SEP in adults was associated with chronic stress (Adler, Epel, Castellazzo, & Ickovics, 2000) and perceived stress (Ghaed & Gallo, 2007).

The non-significant effect of adult objective SEP on stress in pregnancy is consistent with others who found that objective SEP was not associated with chronic and perceived stress (Adler et al., 2000) or psychological health (Singh-Manoux, Marmot, & Adler, 2005) when adjusted for by subjective SEP. Other indirect paths between objective SEP and stress in pregnancy may exist (Appendix I). Our finding that objective SEP predicts subjective SEP is consistent with Singh-Manoux et al.'s proposal, "It is probable that subjective social status may allow a more nuanced judgement of objective indicators of social status and related life chances" (p. 860).

Childhood social support had a small, enduring effect across the life course through its impact on child stress and adult social support. Children with strong social support possess a more adaptive coping style which reduces their stress (Shulman, 1993), but they may also possess

relationship skills, personality traits, or advantageous life circumstances that transfer into adulthood and result in them having high levels of social support in adulthood. The inverse effect of adult social support on prenatal stress is consistent with studies that demonstrated that social support attenuates physiological stress responses (Phillips, Gallagher, & Carroll, 2009). Some of the effect of adult social support on prenatal stress was due to its positive effect on adult family cohesion. This finding concurs with that of Story and Repetti (2004) who found that social support reduced marital conflict and stress. Social support may be related to subjective SEP by contributing to an individual's perception of their rank in the social hierarchy. The social support-prenatal stress relationship may also be mediated by other psychosocial or variables that we did not measure (Appendix J).

Study Strengths and Limitations

Our study has several strengths. The sample was drawn from two community-based centres in different communities, which enhances the representativeness of the findings. Using structural equation modeling, we described direct and mediated pathways originating in childhood and adulthood to pregnancy, extending our knowledge of prenatal stress etiology. As such, our study contributes to the limited body of literature on predictors of stress in pregnancy. Given that past studies have focused on studying prenatal stress in disadvantaged women, this study provides

understanding of influences on prenatal stress in advantaged women. Our study also provided insight into the comparative effects of objective and subjective SEP on stress in childhood and pregnancy.

In evaluating the results of this study, several limitations must be considered. We cannot eliminate the possibility of selection bias by systematically excluding women from our study who did not attend pre-birth clinics at the participating hospitals, although overall our sample characteristics reflect the community-based profiles. Selection bias may also have been introduced through the relatively low participation rate of the study. The childhood measures were retrospective and we acknowledge that women's perceptions of their childhood may be altered by their adult circumstances or mood. We did not measure or control for mood, and were unable to assess its impact on relationships between subjective childhood factors and stress in pregnancy. However, mood congruent recall has been found to be a greater issue with short-term than long-term recall (Blaney, 1986; Matt, Vazquiz, & Campbell, 1992). Also, we could not account for differing impressions and perceptions that may occur as a result of developmental transitions from childhood to adolescence. Finally, the low prevalence of preterm birth in the sample precluded the analysis of our secondary research questions. Similar to other studies of determinants of preterm birth, obtaining an adequate

sample size is problematic given the relative rarity of this outcome (Kramer et al., 2009).

Implications

The epidemiology of maternal stress has immense potential to inform public health intervention aimed at reducing stress-related fetal, neonatal, child, adolescent, and adult outcomes across the life course. The findings support a need to consider the contributions of factors in childhood and adulthood to stress during pregnancy, and may have important ramifications for both surveillance and clinical care. In terms of surveillance, these findings direct our attention to the need for a life-course epidemiologic framework that accounts for early influences on adult disease, and a psychosocial perspective that enables an assessment of health that extends beyond mortality and current definitions of severe morbidity.

Clinically, these findings can be used to expand existing biomedical risk assessment approaches by informing the development of prenatal psychosocial assessment instruments and interventions that target women pre-conception. A strengths-based approach may benefit women by helping them to identify and understand influences on their level of stress, gain insight into and mobilize their current stress-reducing coping strategies, and develop and engage healthy coping processes. Given the role that family cohesion plays, our findings also substantiate the need for

a family-centred approach in the assessment and intervention of women's psychosocial needs.

Conclusion

Based on a community-based sample of largely advantaged, Caucasian women, our findings revealed that perceived stress in childhood was significantly associated with stress in pregnancy after controlling for socioeconomic, family, and support variables in childhood and adulthood. Comparatively, subjective SEP in adulthood had the largest direct effect of all stressors on prenatal stress. Similar magnitudes of effect were noted for childhood SEP, adult/child family cohesion, and adult social support. Objective SEP in adulthood and childhood had negligible impacts on prenatal stress. Childhood factors also acted indirectly to impact adult factors that affect stress. Given that this is the first study to assess the influence of early life stress on prenatal stress, future studies should continue to explore these processes in diverse samples of pregnant women. In addition, further study of the mechanisms by which childhood factors influence prenatal maternal stress would inform prevention and intervention efforts.

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Chapter Four

Measurement of Stress in Childhood and Pregnancy

Abstract

BACKGROUND: Prenatal maternal stress has been implicated in having a role in adverse health outcomes across the life span, yet few measures of maternal stress are available. The purpose of this study was to conceptualize and measure perceived stress in pregnancy and childhood perceived stress, and to evaluate the validity and reliability of these two measures. **METHODS:** We tested a structural equation model comprised of latent variables representing perceived stress in childhood and pregnancy in a multi-centre community-based sample of pregnant women (N = 421). Women completed questionnaires following their pre-birth clinic visit. **RESULTS:** The mean gestational age at questionnaire completion was 28.2 (SD = 5.3) weeks. Questionnaire return rate was 74%. Perceived childhood stress and prenatal maternal stress were each conceptualized as a single, latent variable. The childhood perceived stress measure was comprised of one item related to perceived family stress and three global perceived stress items. The construct of perceived stress in pregnancy differed from childhood. Perceived stress in pregnancy encompassed items of perceived financial and family stress and global measures of recent and more distant past perceived stress, suggesting that it reflected chronic stress. Initial analyses provide evidence of reliability and validity in this sample. **CONCLUSIONS:** Both measures have utility for research, surveillance, and clinical screening. These

measures contribute to our understanding of the construct of perceived childhood and prenatal maternal stress and inform the timing and nature of effective prevention and intervention approaches.

Background

Prenatal Maternal Stress

Prenatal maternal stress has been implicated in having a role in adverse health outcomes across the life span. In addition to neonatal and childhood effects, a growing body of observational evidence suggests that maternal stress may result in permanent changes in the fetal brain that have long-term psychopathological, metabolic, endocrine, and cardiovascular sequelae in adulthood (Kajantie, 2006; McEwen, 2007). However, the etiology of stress is poorly understood (Kramer et al., 2009), and may, in part, reflect the inadequate conceptualization and measurement of stress in pregnancy (Kramer et al., 2001; Lobel, 1994; Monroe, 2008).

Approaches to Conceptualization and Measurement of Prenatal Maternal Stress

Since the mid-1980s, the major issue in stress measurement has revolved around the conceptualization and utility of life event versus perceived stress measures. Early conceptualizations of stress in the pregnancy literature viewed it as an external influence (e.g., life event) that had a uniform influence on all individuals. Life event measures are still widely used in studies of measurement of stress in pregnancy, although they are criticized for not accounting for perceptions of the event's impact

that may be related to personal or contextual factors (Cohen, Kamarck, & Mermelstein, 1983).

Most studies measuring stress in pregnancy have based their conceptualization of stress on Lazarus and Folkman's (1984) theory of transactional stress. Although this theory describes stress as a process of stimulus, appraisal, and response, studies of stress in pregnancy have often combined measures representing these process components (Lobel, Dunkel-Schetter, & Scrimshaw, 1992), rather than modeling the process of stress. Similarly, the Perceived Stress Scale (PSS), the most widely used measure of perceived stress, has been shown to be comprised of two factors (i.e., distress and coping/control) (Cercle, Gadea, Hartmann, & Lourel, 2008), yet it is typically summed into one total score. Although combined measures have demonstrated associations with outcomes, further advancement in understanding the relationship between stress and outcomes requires measuring and modeling the components of stress as a process, and this necessitates the measurement of perceived stress as a unique construct. This approach may have greater potential to inform prevention and intervention efforts than combined measures in that it could facilitate discrimination of the nature of the problem as the stressor, stress appraisal, or coping response. Existing instruments based on transactional theory conceptualize perceived stress as a response to

either a non-specific stressor (e.g., PSS; Cohen et al., 1983) or a specific stressor (e.g., Stress Appraisal Measure; Peacock & Wong, 2006).

Another focus of stress measurement research has been the temporal aspect of the stress. Chronic stress has been linked to more severe health problems than acute stress (Miller, Chen, & Zhou, 2007), and a recent review found that stressor chronicity was fundamental in predicting cortisol changes (Michaud, Matheson, Kelly, & Anisman, 2008). However, chronic stress has been studied substantially less than acute stress and is poorly conceptualized. Chronic stress is differentiated from acute stress in that it: (a) comprises an environmental stressor that *remains* in the environment for a prolonged period or *continues* to exert an effect even when the stressor is absent; (b) an appraisal of the stressor as threatening; and (c) biobehavioural responses (Baum, Cohen, & Hall, 1993; Miller et al.). To our knowledge, no measures of perceived chronic stress in pregnancy have been developed.

Overall, the little existent research on stress measurement in pregnancy is limited in its: focus on measuring stress in disadvantaged populations; utilization of multiple stress measures without distinguishing between them when interpreting study results; inconsistent differentiation between stress and anxiety; lack of modeling of the process of stress; and measurement of acute stressors occurring primarily during pregnancy. In our estimation, the latter issue is of particular importance because

studying stress in pregnancy apart from the context of a woman's life regards pregnancy as an isolated period, rather than a part of the continuum of a woman's life.

An Expanded Approach to Prenatal Maternal Stress Measurement: Childhood Determinants

Life course theory, the study of biological, behavioural, and psychosocial processes that operate across an individual's life to influence disease risk in adulthood (Kuh & Ben-Shlomo, 2005), has utility for studying stress in pregnant women as it contextualizes the problem of stress in pregnancy within the framework of a woman's life. Since a life course approach requires an assessment of current and pre-conception determinants of stress, this framework provides a plausible approach for developing specific models of childhood determinants of stress (Hogue, Hoffman, & Hatch, 2001; Kramer et al., 2001; Shannon, King, & Kennedy, 2006; Tiedje, 2003). No studies to date have explored early life determinants of stress in pregnancy. Although evidence provides strong rationale for pursuing childhood stress as an early determinant of stress in pregnancy (Luecken, Kraft, Appelhans, & Enders, 2009; McEwen, 2007; McEwen & Seeman, 1999; Nemeroff, 2004; Olff, Langeland, & Gersons, 2005), research in this area has been restricted by the lack of psychometrically rigorous measures of childhood stress.

Measurement of Childhood Stress

General considerations. Measurement of stress in childhood suffers from similar challenges as those found in adult measurement, such as the lack of clarity in definition and theoretical conceptualization (Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001). Few child stress instruments have been designed for use in general, non-clinical populations or have been rigorously psychometrically evaluated (Kanner, Feldman, Weinberger, & Ford, 1987; Coddington, 1972). They are almost solely based on life event checklists, which, similar to adult versions, are quite dated despite evidence that children's stressors are different across time periods/generations (Ryan-Wenger, Sharrer, & Campbell, 2005).

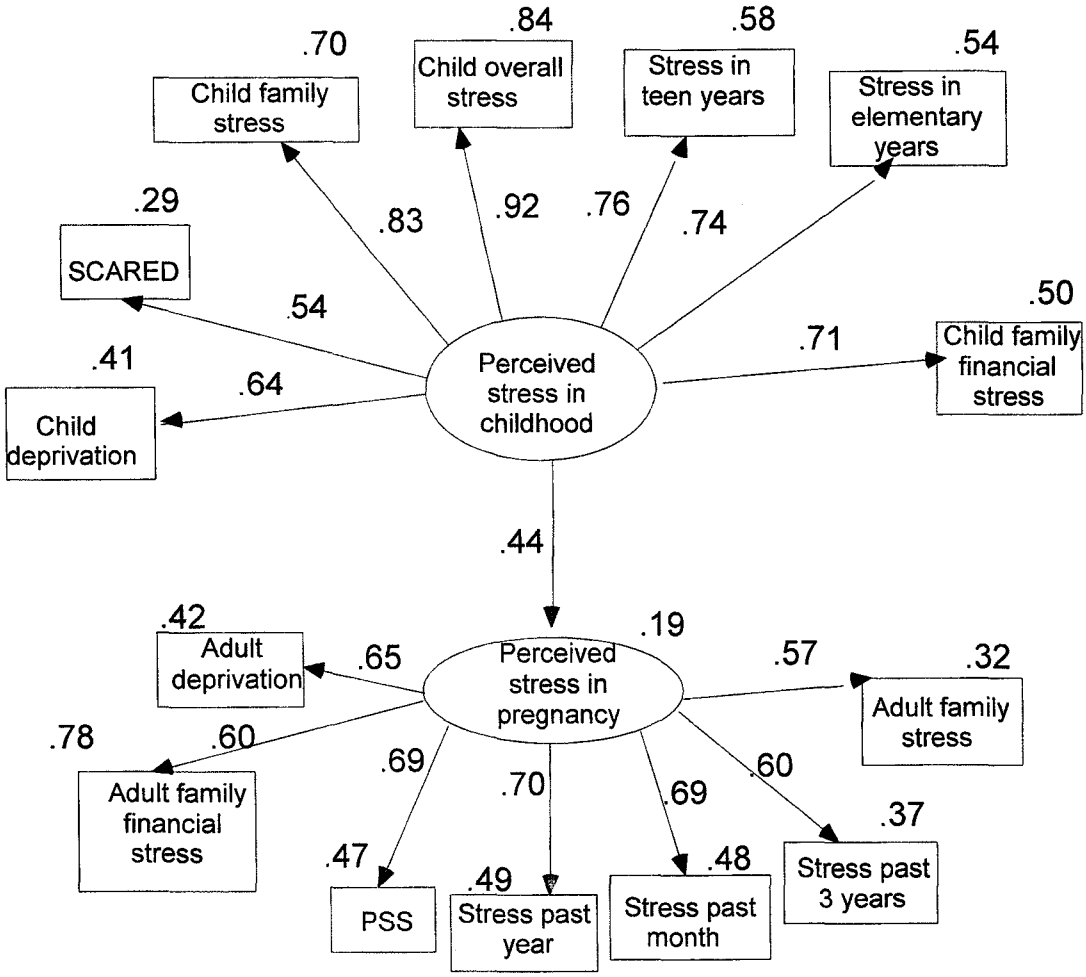
Approaches to measuring childhood stress. Renewed interest in the long-term effects of intrauterine and childhood influences has refreshed the debate about how to best collect these data. While prospective data collection using birth cohorts is preferred over retrospective data collection, the advantages must be balanced by considerations such as identifying a birth cohort that links exposures and outcomes of interest, the delay before outcome data are available, the tendency toward high drop-out rates, and the large expense. Moreover, few birth cohorts collect data on psychosocial exposures in pregnancy or childhood. As such, retrospective measures of childhood stress may be a

useful alternative to studying the etiology of psychosocial roots of adult disease. In support of this approach, the central features of adult recollections of predominant childhood events and circumstances have been found to be reasonably accurate and generalized assertions that all retrospective reports are unreliable are unwarranted (Brewin, Andrews, & Gotlib, 1993; Widom, Raphael, & DuMont, 2004). Some have also advocated for the cautious use of retrospective measures of subjective variables (Cournoyer & Rohner, 1996; O'Campo & Schempf, 2005). We found no instruments designed to assess childhood perceived stress.

Model Overview

The proposed stress measurement model (see Figure 1) is a component of a larger model, the Life Course Stress and Preterm Birth Model (Chapter 2). The measurement components for perceived stress in childhood and pregnancy are similar in structure. An unmeasured, latent variable denotes a global construct of perceived stress, which represents an underlying cause of various measured indicators of perceived stress. To be consistent with Lazarus and Folkman's (1984) transactional theory, we have modeled stressors as predictors of perceived stress. Perceived stress indicators are measured globally, during certain periods of time (e.g., the past month, during teen years), and by the impact of specific potential stressors (e.g., finances, family).

Figure 1. **Proposed Model of Perceived Stress in Childhood and Pregnancy.**



Note. In structural equation models, the rectangles depict measured, *observed variables* (i.e., indicators) and ovals represent unmeasured *latent variables* (e.g., perceived stress in childhood). Latent variables represent constructs that are difficult to measure. Multiple measured indicators are used to define latent variables. "e" represents the error associated with the pathway between the latent variable and the indicator. The value above each observed variable (e.g., .29 above the SCARED indicator) is the R^2 value, the proportion of variance that is accounted for in that particular variable by the latent variable (i.e., a measure of reliability). The values on the pathways between the latent and observed variables (e.g., .54 between the perceived stress in childhood latent variable and SCARED indicator) are the standardized regression coefficients and are termed "factor loadings" in measurement models. Factor loadings are measures of validity.

Purpose

The overall purpose of this study was to conceptualize and measure perceived stress in childhood and pregnancy and to assess the validity and reliability of these instruments. Two psychometrically-evaluated instruments, the Screen for Child Anxiety Related Emotional Disorders (SCARED) (Birmaher et al., 1997) and the Perceived Stress Scale (PSS) (Cohen et al., 1983), were included in the model to assess criterion validity.

The specific research questions were:

1. What is the factor structure of perceived stress in childhood, and what indicators best conceptualize this construct?
2. What is the validity and reliability of the measure of perceived stress in childhood?
3. What is the factor structure of perceived stress in pregnancy, and what indicators best conceptualize this construct?
4. What is the validity and reliability of the measure of perceived stress in pregnancy?

We hypothesized that perceived stress in childhood and pregnancy would each be conceptualized by a single, latent variable; however, the indicators of perceived stress would differ between childhood and pregnancy. We expected that the specific indicators would provide insight

into the constructs of perceived stress in childhood and pregnancy and that the validity and reliability of the final models would be satisfactory.

Methods

Participants

Women were recruited consecutively from pre-birth clinics in two community-based hospitals in two centres in south-western Ontario between September, 2007 and March, 2008. Both hospitals serve a largely Caucasian population, are the only local centres with obstetric services in their communities, and have level II neonatal nurseries with annual deliveries of 1500 (site 1) and 4500 (site 2). Both sites are located in communities with an above-average household income and proportion of post-secondary educated residents and lower unemployment rates compared to other similarly sized Ontario communities. Over 90% of women who plan to deliver at these centres attend the pre-birth clinics, typically during their 18th to 24th week of gestation. During the pre-birth clinic visit, a Registered Nurse meets individually with the pregnant woman (and her significant other) to complete registration information for her labour and delivery admission and provide educational materials. Approval of this study was obtained from the Hamilton Health Sciences/McMaster University Faculty of Health Sciences Research Ethics Board (#07-035) and the ethics committee that served both hospitals.

Sampling and Recruitment

Women were eligible for this prospective cohort study if they: (a) were ≥ 16years at the time of recruitment; (b) spoke/read English; and (c) were pregnant with a singleton infant. Women were excluded if they were not expected to deliver at one of the recruiting sites. Two Registered Nurses in each pre-birth clinic who had received training on the participant recruitment and study procedures were responsible for asking each woman who met the inclusion criteria if she was interested in participating in the study. The nurses also obtained signed informed consent for participation.

Sample size calculation for SEM depends upon a number of factors, including size and complexity of the model, psychometric properties of the measures, strength of the relationships among the variables, and normality of the data (Raykov & Marcoulides, 2006). Raykov and Marcoulides indicate that "no easily applicable and clear-cut general rules of thumb [for sample size] have been proposed" (p. 30) that consider these varying aspects. Kline (2005) suggests that over 200 cases should be considered for complex models. Based on these considerations, sample sizes of existing studies of stress and preterm birth using SEM, and non-participation and loss to follow-up rates from studies of maternal health conducted by research team members (WS, PK), we calculated a

final sample size of 470 women allowing an additional 30% to offset non-participants and dropouts.

Data Collection

A modified Dillman approach (Dillman, 2007) was used to survey pregnant women in order to enhance response rates. After the women provided written consent at their clinic visits, they were given a questionnaire to complete at home and mail back to the investigator in a self-addressed, pre-stamped envelope within 1 week. A follow-up thank-you/reminder letter was mailed to each participant at 1 week and reminder letters to women who had not returned the questionnaire were sent 3 and 6 weeks after the clinic visit, with a second questionnaire included in the 6-week mailing (Dillman). The prenatal questionnaire incorporated measurement instruments, and gathered sociodemographic and health-related information. Investigator-developed items were reviewed by content experts for face and content validity. The questionnaire was reviewed by survey methodology experts and pilot-tested in 10 women who were 20 to 40 years of age to establish the clarity of the instructions and items, provide suggestions for alternate wording, and to identify items that needed to be added or removed. Recommendations from the pretesting process were incorporated into the final questionnaire. Other data related to gestational age were obtained through the Niday Database, Ontario's perinatal database. One research assistant

coordinated questionnaire follow-up mailings, a second research assistant entered questionnaire data into the statistical database, and the primary investigator added secondary outcome data to the database. Processes were incorporated for verifying data entry.

Measurement of Model Variables

Perceived Stress

Global perceived stress in childhood. Global perceived stress during specific periods of childhood was measured using the 3-item Global Perceived Early Life Stress scale (GPELS) which assesses perception of overall stress during the preschool (age 0-5 years), pre-teen (age 6-12 years), and teen years (age 13-16 years) compared to stress experienced by peers (Carpenter et al., 2004). The piloting of the prenatal questionnaire revealed that most women could not recall their level of stress during preschool years, and therefore this item was removed from the final questionnaire. Psychometric evaluation of this tool has been conducted but not published (personal communication, L. Carpenter, November 25, 2006), and is unavailable.

Because no existing measures of childhood perceived stress were available, a psychometrically evaluated measure of a related construct (i.e., anxiety) was included. The 7-item Generalized Anxiety Disorder (GAD) subscale of the Screen for Child Anxiety Related Emotional Disorders (SCARED) comprises self-report questions intended to screen

for anxiety disorders in children (Birmaher et al., 1997; Birmaher et al., 1999). The GAD subscale has good internal consistency of 0.7 to 0.9 and test-retest reliability of 0.6 to 0.9 (Birmaher et al., 1999).

Global perceived stress in pregnancy. Global perceived stress in pregnancy was evaluated through the use of (a) investigator-developed global stress items (e.g., Overall, how much stress are you experiencing *at this time* in your life? Overall, how much stress have you experienced *during the past year*? Overall, how much stress have you experienced during the past 3 years?) with 5-point Likert scale responses ranging from *none* to *a great deal,* and (b) the Perceived Stress Scale (PSS) (Cohen et al., 1983). The 10-item version of the PSS has superior internal reliability compared to the original 14-item version and has a Cronbach's alpha ranging from .78 to .93 in diverse groups of adults (Cohen & Williamson, 1988). The PSS has been used in studies of pregnant women (Heaman, Blanchard, Gupton, Mottatt, & Currie, 2005; Kramer et al. 2009; Stancil, Hertz-Picciotto, Schramm, & Watt-Morse, 2000). Chronic stress was differentiated from this acute stress measure with two additional items that asked women how stressful the past year and 3 years had been for them, offering ranges of responses from *extremely stressful* to *not at all stressful.*

Perceived impact of socioeconomic and family stress. The appraised impact of childhood socioeconomic and family environment

stressors was evaluated retrospectively through an investigator-developed measure that followed each item related to socioeconomic and family circumstances (e.g., "How stressful was this situation for you as a child?"). Socioeconomic circumstances were related to wealth (e.g., home ownership), receipt of welfare benefits, change in financial situation (i.e., positive or negative), perception that the family did not have enough money for necessary and/or unnecessary things, perception that the family struggled financially, and overall sense of deprivation related to the family or financial situation. Stress related to the family was assessed by a single item asking about the overall amount of stress experienced because of family relationships or functioning. Perceived impact of stress related to current socioeconomic and family environment stressors was measured concurrently (e.g., "How stressful is this situation for you?") using the same items as those for childhood, but written in present tense. These questions used a 5-point Likert scale, ranging from *very stressful* to *not stressful at all.*

Family Environment

Family environment in childhood was conceptualized in the model as a latent variable with six observed variables: four subscales of the Parental Bonding Inventory (PBI) (e.g., father care, father protection, mother care, mother protection); the cohesion subscale of the Family Adaptability and Cohesion Evaluation Scale III (FACES-III); and the

General Functioning subscale of the McMaster Family Assessment Device (FAD). The 50-item PBI was used to assess the quality of parental relationships during childhood. The PBI is intended for retrospective use (Parker, 1989; Parker, 1990). The two-part tool asks participants to respond to statements as they remember their mother (25-items) and father (25-items) during their first 16 years of life (Parker, 1989). As recommended, a "father-figure" or "mother-figure" was the referent for those without fathers or mothers (Parker, 1990). Reliability of the care scales is .91 - .93 and for the protection scales it is .87 - .88 (Richman & Flaherty, 1986).

The FACES-III cohesion subscale was used to evaluate cohesion in the childhood and adult family. The 10-item cohesion subscale has an internal consistency of .77 (Neabel, Fothergill-Bourbonnais, & Dunning, 2000). The 12-item General Functioning Subscale of the FAD was used to assess family functioning of the woman's current and childhood family. It includes problem solving, communication, roles, affective responsiveness, affective involvement, and behaviour control (Neabel et al., 2000). This subscale has been found to have good internal consistency (Cronbach's α = .86) and construct validity (Byles, Byrne, Boyle, & Offord, 1988).

Socioeconomic Position (SEP)

Objective SEP. Child and adult objective SEP were represented by separate indices created by summing weighted items related to the

childhood family or current family. All scores were converted from their original scaling to a score out of 8, the highest number of response categories among the items in the index. Converted scores were then summed together so that each of the original scales contributed equally to the weighted index. Specific questions that comprised the indices were related to (a) average household social class based on the average of the National Statistics Socioeconomic Classification (NS-SEC) for mother/father for the childhood index and own/partner for the current social class, (b) average household education based on the average father/mother education for childhood index and own/partner education for adult index, (c) wealth (ownership of house during childhood and at present), and (d) household income of current household (in adult index only).

Subjective SEP. Adult and child subjective SEP were each conceptualized as a latent variable with six indicators. Subjective social status was measured using the MacArthur Scales of Subjective Social Status. Using an image of a ladder, participants placed a single "x" on one of the 10 rungs of the community ladder representing where they believe they stood in their community. Perception of social standing on this ladder encompasses a sense of personal importance in the community (Singh-Manoux, Adler, & Marmot, 2003). A second ladder, the SES ladder, asked respondents to rank themselves based on their occupation, education,

and income compared to others in their country (Singh-Manoux et al.). This ladder reflects more traditional aspects of SEP. In a study of adolescents, reliability of the SES ladder was .73 and .79 for the community ladder (Goodman et al., 2001). No specific reliability estimates have been reported for adults. Other investigator-developed items assessing subjective social status were related to the perception of economic adversity: perception of duration of adversity; degree of adversity (e.g., perception of having enough money for necessary and unnecessary things, a global measure of perceived deprivation); and perceived impact of changes in financial circumstances. Questions were asked in relation to both the period of childhood and the present time.

Social Support

The 60-item CASSS measures childhood perceived social support using subscales related to parental, teacher, classmate, and close friend support (Malecki & Demaray, 2002). Because items in the parental subscale are similar to those in the selected family instruments, this subscale was not used. Coefficient alpha of the total scale is high in both elementary (.96 - . 97) and high school (.97) students (Demaray & Malecki, 2002). Perceived social support during adulthood was measured using the 12-item version of the Interpersonal Support Evaluation List (ISEL-12) (Cohen, Mermelstein, Kamarck, & Hoberman, 1985). The ISEL-12 evaluates tangible assistance or material aid, appraisal of support or

the availability of a confidant, and belonging support or the availability of another for fun/relaxation (Cohen et al.). Cronbach's alpha is .81 in adults (Cohen et al.).

Other Risk Factors for Preterm Birth

Using investigator-developed items, women were asked whether they had ever had a premature baby, to self-report their ethnicity from a structured list, whether they considered their daily work routine as physically demanding (yes/no), and how many cigarettes they smoke per day currently and just before they became pregnant. Maternal health conditions and any complications experienced during pregnancy, labour, and/or delivery were obtained from the Niday Database.

Other Risk Factors for Prenatal Stress

Three additional potential risk factors for prenatal stress were self-reported: number of weeks gestation, parity, and age. Number of weeks gestation at the time of questionnaire completion was assessed because previous studies have demonstrated that maternal stress is attenuated with advancing gestation (Glynn et al., 2001). Parity and maternal age were also determined because we expected that they may impact perceived maternal stress.

Data Analysis

Analytic Procedure

We used SEM to simultaneously assess the factor loadings between the latent variables and their respective observed measures (i.e., indicators) and the error associated with each factor loading. Roesch (1999) suggested that latent variable modeling is beneficial for stress measurement because the fragmented conceptualization of stress across multiple disciplines has resulted in ambiguity and inconsistency regarding the nature of stress. In addition, measurement error has been noted to be a particular problem for stress indices (Thoits, 1991). Analyzing latent variable models with SEM allows the separation of measurement error from construct measurement (Byrne, 2001), offering a more reliable definition of stress (Woods-Giscombe & Lobel, 2008).

The assumption of multivariate normality was evaluated by assessing univariate distributions using histograms, bivariate relationships using bivariate scatterplots, reviewing skew statistics based on established guidelines whereby an absolute value of the kurtosis index <10 suggests normality, and by assessing distributions for outliers (Kline, 2005). We used maximum likelihood estimation for estimation of means, variances, and covariances of the variables in order to retain records with missing data in our analysis. Maximum likelihood estimation is a preferred estimation method because it offers a more efficient and consistent

approach with less bias in handling *missing-at-random* data than pairwise or listwise deletion, or single imputation (Byrne, 2001).

We assessed and modified the childhood model first, followed by the pregnancy portion, and then joined the child and pregnancy models together in a final, integrated model. Model assessment was based on the fit of individual factor loadings and the fit of the entire model. Specifically, the fit of the factor loadings was evaluated based on the feasibility of parameter values in terms of size, sign, consistency with theory, the size of the standard errors, and the statistical significance of the factor loading (Byrne, 2001). The fit of the overall model was assessed based on model fit statistics. The minimal set of analyses recommended for SEM analyses (Kline) were assessed, including the model chi-square, the Steiger-Lind root mean square error of approximation and its 90% confidence interval (RMSEA) (Steiger, 1990), and the Bentler comparative fit index (CFI) (Bentler, 1990). The CFI ranges from .000 to 1.00; values greater than .90 are indicative of a good fit, although some suggest that .95 should be used as a cut-off (Byrne; Kline, 2005). Similarly, the higher the RMSEA, the poorer the fit, with zero indicating the best (but not perfect) fit. Values less than .05 suggest close fit between the population and model-implied covariance matrix as estimated using sample data, values between .05 and .08 indicate reasonable fit, and those greater or equal to .10 indicate poor fit (Kline).

Modification of the model was guided by the theoretical plausibility of the pathway, the assessment of the fit of the factor loadings and overall model, and the impact of the amendments on other factor loadings in the model (Kline, 2005). Some amendments to the model involved the deletion or restructuring of pathways as well as the addition of error covariances (i.e., correlated errors) between indicators. Given that error covariances may suggest either redundancy (i.e., both indicators measure the same construct and only one is needed) (Byrne, 2001), or relatedness that may require modeling of both indicators on a separate latent variable (Wheaton, 1987), we evaluated both alternatives prior to the permanent addition of an error covariance in the model. Statistically non-significant ($p < .05$) pathways were removed from the final model to enhance parsimony if the overall model fit or the stability of other factor loadings (Wheaton) was not adversely affected by their deletion. Pathways that were comparatively lower than other factor loadings were also considered for deletion if their loadings suggested conceptual inconsistency with other indicators. Care was taken to avoid "over-fitting" the model by ceasing modification when an adequate fit was achieved (Wheaton). Analyses were conducted using SPSS (16.0) and AMOS (16.0).

Results

The Sample

The final sample comprised 441 women, 263 from site 1 and 178 from site 2. Participation rate at site 1 was 68.2% and 44.0% at site 2 for an overall study participation rate of 56.4% (639/1133). Of these, 12 women were excluded because their questionnaires were returned post-delivery; one of these women also delivered twins. Our final analysis was based on women for whom outcome data were available (N = 441) with a loss to follow-up rate of 4.1%. Sample characteristics are displayed in Tables 1 through 4. The mean age of women in the sample was 29.8 years (SD = 5.8) and mean gestational age at time of questionnaire completion was 28.2 weeks (SD = 5.3), ranging from 13 to 40 weeks. The majority of women were married or living common-law, had attended community college or university, and were born in Canada. Almost half of the women had household incomes over CAN $80,000 and the mean MacArthur ladder ratings were slightly higher than those reported in the only other study of pregnant women (Ostrove et al., 2000).

Table 1: *Sociodemographic and Family Characteristics of Sample (N = 441)*

Characteristic	*M (SD)*	*n (%)*	
Maternal age (years)	29.8 (5.8)		
Primiparity		190	(43.1)
Marital status			
Married/Common-law		420	(95.2)
Single/Separated		21	(4.8)
Born in Canada		365	(83.0)
Maternal education			
High school or less		80	(18.1)
Some or completed community college		160	(36.4)
Some or completed bachelor's degree		143	(32.5)
Graduate degree		57	(13.0)
Income			
<$10,000		8	(1.9)
$10,000 – $19,999		14	(3.3)
$20,000 – $39,999		61	(14.3)
$40,000 - $59,999		63	(14.7)
$60,000 - $79,999		70	(16.4)
≥$80,000		212	(49.5)
Child family community ladder	6.6 (1.7)		
Child family SEP ladder	6.2 (1.7)		
Adult community ladder	6.5 (1.5)		
Adult SEP ladder	6.4 (1.6)		
Child FACES III	36.2 (7.9)		
Adult FACES III	42.3 (5.8)		

Note. *M* = mean. *SD* = standard deviation. *n* = number of respondents.

Table 2: ***Obstetric Risk Factors and Delivery Characteristics of Sample*** **(*N* = 441)**

Characteristic	*M (SD)*	*n (%)*	
Preterm birth risk factors			
Had previous preterm delivery		33	(7.5)
Smoked before or during pregnancy		79	(17.9)
Physically demanding work		140	(31.7)
Delivery <37 weeks		19	(4.6)
Gestational age at questionnaire completion (weeks)	28.2 (5.3)		
Gestational age at delivery (weeks)	39.2 (1.5)		
Birth weight (grams)	3489 (487)		
Delivery mode			
Vaginal		297	(71.4)
Caesarean section		119	(28.6)

Note. ***M*** **= mean.** ***SD*** **= standard deviation.** ***n*** **= number of respondents.**

Table 3: *Childhood Psychosocial Characteristics of Sample (N = 441)*

Characteristic	*n*	*(%)*
Child stress in elementary school		
Essentially stress free	116	(26.4)
Less stressful than most kids my age	106	(24.1)
About average	147	(33.5)
More stressful than most kids my age	54	(12.3)
Extremely stressful	16	(3.6)
Child stress in teen years		
Essentially stress free	47	(10.7)
Less stressful than most kids my age	108	(24.7)
About average	159	(36.2)
More stressful than most kids my age	100	(22.8)
Extremely stressful	25	(5.7)
Overall stress in childhood		
Extremely stressful	10	(2.3)
Very stressful	36	(8.2)
Moderately stressful	108	(24.6)
Mildly stressful	200	(45.6)
Not at all stressful	85	(19.4)
Child family stress		
Extremely stressful	14	(3.2)
Very stressful	40	(9.2)
Moderately stressful	86	(19.8)
Mildly stressful	158	(36.3)
Not at all stressful	137	(31.5)
Child financial stress[a]		
Extremely stressful	3	(1.3)
Very stressful	24	(10.4)
Moderately stressful	56	(24.2)
Mildly stressful	110	(47.6)
Not at all stressful	38	(8.6)

Note. *n* = number of respondents.

[a]Question was asked of respondents who reported that their family experienced financial stress (*n* = 231)

Table 4: *Adulthood Psychosocial Characteristics of Sample (N = 441)*

Characteristic	*M (SD)*	*n (%)*
Adult Perceived Stress Scale	17.0 (3.9)	
Adult overall how stressful past month		
Extremely stressful		7 (1.6)
Very stressful		46 (10.5)
Moderately stressful		115 (26.1)
Mildly stressful		209 (47.5)
Not at all stressful		63 (14.3)
Adult overall how stressful past year		
Extremely stressful		14 (3.2)
Very stressful		40 (9.1)
Moderately stressful		140 (31.8)
Mildly stressful		204 (46.4)
Not at all stressful		42 (9.5)
Adult overall how stressful past 3 years		
Extremely stressful		7 (1.6)
Very stressful		48 (10.9)
Moderately stressful		154 (35.0)
Mildly stressful		196 (44.5)
Not at all stressful		35 (8.0)
Adult family stress		
Extremely stressful		4 (1.0)
Very stressful		10 (2.3)
Moderately stressful		40 (9.2)
Mildly stressful		178 (40.9)
Not at all stressful		203 (46.0)
Adult financial stress[a]		
Extremely stressful		15 (5.9)
Very stressful		29 (11.4)
Moderately stressful		78 (30.6)
Mildly stressful		114 (44.7)
Not at all stressful		19 (7.5)
Adult ISEL	42.0 (5.3)	

Note. M = sample mean; SD = standard deviation; n = number of respondents by characteristic.
[a]Question was asked of respondents who reported that their family experienced financial stress (*n* = 255)

The vast majority of women's parents were married (85.9%). Almost half of the fathers (46.0%) and mothers (48.2%) had some post-secondary education. Over one-third (35.1%) of women reported that their

childhood was overall moderately to extremely stressful, 32.2% experienced moderate, high, or extreme stress due to their families, and of the women who reported their that their childhood family experienced financial difficulties (52%), 35.9% reported moderate, high, or extreme stress due to the family financial situation. Almost half (47.5%) of the women reported scores of "recalled" childhood anxiety above the screening cutoff of 9 on the GAD, suggesting increased risk of Generalized Anxiety Disorder. Considering their current circumstances, 38.2% of women indicated that they experienced moderate to extreme levels of stress during the past month, 44.1% during the past year, and 47.5% during the previous three years. The majority of women reported that they had experienced *any level* of stress during the past month (85.7%), the previous year (90.5%), and the previous three years (92.0%). Thirteen percent of women experienced stress related to their current family, and of the women who reported experiencing financial stress (57.8%), 47.9% indicated that they found this circumstance to be moderately to extremely stressful.

Research Question 1: What is the factor structure of global perceived stress in childhood and what indicators best conceptualize this construct?

Factor structure of childhood perceived stress. Assessing the factor structure of perceived stress was important because it provided a

conceptual understanding of the composition of stress and methodologic direction in terms of whether to sum indicators (i.e., items) together or as subscales. We evaluated whether childhood stress was best modeled by a single or two-factor structure by testing three different two-factor models (models 2 to 4; Table 5). Based on controversy in the stress measurement literature regarding life events and perceived stress, we assessed whether childhood perceived stress was conceptualized by two latent variables: (a) a global sense of perceived stress, and (b) perceived impact event stress (models 2 and 3; Table 5). These models were either inadmissible or poorly fitting. Next, given that an error covariance between stress in teen and elementary years indicated that these variables may share a common, underlying cause that could be modeled as a separate latent variable, we assessed whether childhood stress was conceptualized by (a) a global sense of perceived stress; and (b) a "stress by period" latent variable (model 4; Table 5). Although the model was well-fitting (Table 5), the covariance correlation was very high ($r = .93$; $p < .001$), suggesting that these constructs were highly related and not truly distinct. Theoretically, it was also difficult to interpret the meaning of the latent variable as defined by elementary and teen stress indicators.

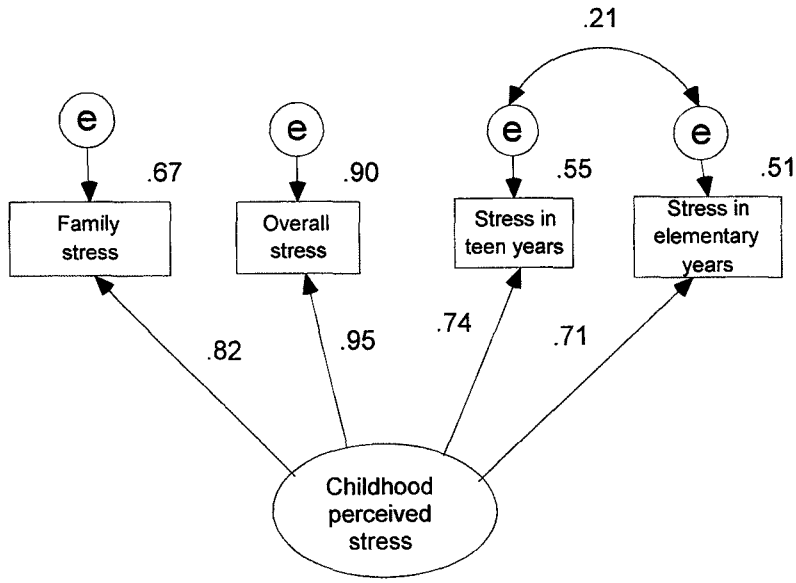
Table 5: *Summary of Analysis of Childhood Perceived Stress Model* (*N* = 441)

Model Number	Model Description	X2 (df, p-value, ratio)	CFI	RMSEA (90% CI)
1	Original proposed child model (see Figure 1) (includes deprivation)	69.3 (14, $p < .001$, 4.9)	.963	.095 (.073 - .118)
2	Two-factor model. Latent variables included (a) overall perceived stress indicators (overall stress, stress in teen years, stress in elementary years) and (b) perceived event impact stress (financial stress, family stress, SCARED) Note: The covariance between the latent variables was 1.03, therefore the model was inadmissible.	20.5 (7, $p = .005$, 2.9)	.989	.066 (.034 - .100)
3	Two-factor model. Latent variables included (a) "overall perceived stress" (overall stress, family stress, financial stress) and (b) perceived event impact stress (financial stress, family stress, deprivation) Note: The covariance between latent variables was .93 ($p < .001$)	41.9 (8, $p < .001$, 5.3)	.975	.098 (.070 - .128)
4	Two-factor model. Latent variables included (a) "overall perceived stress" (overall stress, family stress, financial stress) and (b) perceived stress by time periods (stress in teen years, stress in elementary years) Note: The covariance between latent variables was .93 ($p < .001$)	9.4 (4, $p = .052$, 2.3)	.995	.055 (.000 - .102)
Amendments to Original Proposed Child Model (single latent variable)				
5	Deletion of SCARED indicator	56.9 (9, $p < .001$, 6.3)	.965	.110 (.084 - .138)
6	Addition of error covariance between teen and elementary stress indicators Note: The error covariance = .18 ($p = .002$)	46.2 (8, $p< .001$, 5.8)	.972	.104 (.076 - .134)
7	Deletion of deprivation indicator	9.4 (4, $p = .05$, 2.31)	.956	.055 (.00 - .102)
8	Deletion of financial stress indicator Note: Final child model (see Figure 2)	2.2 (1, $p < .13$, 2.2)	.999	.053 (.000 - .150)

Indicators of childhood perceived stress. Given that none of the two-factor models were satisfactory, further analyses were conducted on the proposed childhood stress model (model 1; Table 5). This model was a poor fit to the data (Table 5). We had originally included the SCARED indicator to assess validity in the absence of other existing childhood stress measures. It was deleted due to its comparatively low factor loading and R^2 value, which suggested that it was conceptually less related to childhood perceived stress than the other indicators. Little change resulted in the other factor loadings with the removal of SCARED. Given that the factor loadings of stress in elementary and teen years were similar, and these two variables were highly correlated (r = .63) (Appendix K), we assessed whether only one of these indicators was necessary in the model. However, eliminating either of these indicators produced a deterioration in model fit. Given that most children who experience stress during their elementary years are likely to also experience stress in their teen years, an error covariance was added between these two indicators. The error covariance was statistically significant and resulted in model improvement; however, model fit statistics suggested that the model was still poorly fitting. Although the deprivation indicator had a statistically significant factor loading and an R2 value of .42, its deletion vastly improved the model fit, suggesting that it was less conceptually aligned with childhood stress than the other indicators (Table 5). Little change was

observed across the other factor loadings with its removal. The final childhood stress model was therefore comprised of four indicators: perception of overall stress (r = .95), stress during elementary years (r = .71), stress during teen years (r = .75), and family stress during childhood (r =.82) (see Figure 2). All factor loadings and the error covariance were statistically significant at the level of $p < .001$.

Figure 2. **Final Model of Childhood Perceived Stress.**



Note. In structural equation models, the rectangles depict measured, *observed variables* (i.e., indicators) and ovals represent unmeasured *latent variables* (e.g., childhood perceived stress). Latent variables represent constructs that are difficult to measure. Multiple measured indicators are used to define latent variables. "e" represents the error associated with the pathway between the latent variable and the indicator. The value above each observed variable (e.g., .67 above the family stress indicator) is the R^2 value, the proportion of variance that is accounted for in that particular variable by the latent variable (i.e., a measure of reliability). The values on the pathways between the latent and observed variables (e.g., .82 between the latent variable and family stress indicator) are the standardized regression coefficients and are termed "factor loadings" in measurement models. Factor loadings are measures of validity. In Figure 2, each factor loading is statistically significant at the $p < .001$ level.

Research Question 2: What is the validity and reliability of the childhood perceived stress model?

Validity of the childhood perceived stress model. Validity, the degree to which an instrument measures what it is intended to measure, is assessed in structural equation models by examining the magnitude of the factor loadings. In the final child stress model, factor loadings were high, ranging from .71 to .95, which suggested that each of the indicator variables was highly correlated with perceived child stress. As another assessment of validity, we included a measure of clinical anxiety (i.e., SCARED) in the model. As hypothesized, the SCARED indicator was less related to the childhood stress latent variable than the other stress indicators, having the lowest factor loading and R^2 value (see Figure 1).

However, assessing the validity of retrospective measures is a complex process and involves evaluating whether the instrument measures the *actual* construct (i.e., the measure accurately evaluates the construct as it was at the time of occurrence) or the *perceived* construct (i.e., the measure accurately evaluates a past perception or feeling). For our study, given that our measure is one of perception, validity issues centre around whether the measure accurately evaluates stress as it was perceived in childhood, or whether that perception may be influenced by current context. To assess the accuracy of stress as it was perceived in childhood, we conducted two sub-analyses. First, we evaluated the

relationship between objective childhood stressors and child perceived stress. An obvious caveat is that the lack of association between a childhood stressor and stress may indicate lack of validity of the stress measure, or it may suggest that the stressor did not elicit a stress perception. Acknowledging these qualifications regarding this analysis, statistically significant correlations were found between childhood stress and receiving childhood support (r = -.36), family receiving welfare (r = .22), not having money for necessary (r = .55) or unnecessary things (r = .53), parents being unmarried (r = .26), father being unemployed (r = .27), family spending free time together (r = -.50), family asking each other for help (r = -.50), and other people telling me I worried too much (r = .32). The direction of each correlation was as expected.

Secondly, we assessed the relationship between the childhood stress latent variable and the Parental Bonding Inventory (PBI), a widely used, psychometrically well-tested instrument designed to retrospectively measure the quality of parental relationships (Parker, Tupling, & Brown, 1979). Our hypothesis that the PBI would be associated with childhood perceived stress was based on the notion that if a woman's recall of past perceptions was accurate, her perception of her past stress would be related to her perception of her parental relationships during childhood. This, too, is an imperfect approach to assessing validity because factors that influence women's past recall could act on her remembrance of both

childhood stress and parenting quality. However, as expected, childhood stress was negatively associated with the maternal care subscale of the PBI (r = -.54; p < .001) and positively associated with the maternal overprotection/control subscale (r = .34; p < .001). Finally, as hypothesized, our measure of childhood stress had a significant, independent effect on stress in pregnancy, even after adjustment for childhood family cohesion, childhood subjective socioeconomic position (SEP), adult subjective SEP, adult family cohesion, and adult social support. The issue of whether the current mood influences perception of childhood stress is more difficult to disentangle. Because we did not measure other aspects related to mood, we could not assess whether current mood influenced perceptions of childhood stress

Reliability of the final childhood perceived stress model. In SEM, reliability has been defined as the variance in the variable that is not accounted for by measurement error (Hancock, 1997), and it answers the question, "To what extent are the observed variables actually measuring something else other than the latent variable" (Schumacker & Lomax, 2004, p.201). The proportion of variance in the indicator variable accounted for by the latent variable (perceived stress) is represented by the squared multiple correlation coefficient (R^2). The amount of error associated with the measurement of the indicator-latent variable relationship is calculated by 1 – R^2. In the final model, R^2 values ranged

from .51 to .90 (Figure 2). The latent variable accounted for the greatest proportions of variance in overall stress (R^2 = .90) and family stress (R^2 = .67). The smallest measurement error was associated with the overall indicator of childhood stress and the most with stress during elementary years.

Research Question 3: What is the factor structure of global perceived stress in pregnancy and what indicators best conceptualized this construct?

Factor structure of perceived stress in pregnancy. The proposed, single-latent adult model was poorly fitting (Table 5). A two-factor pregnancy model comprised of a global perceived stress latent (e.g., PSS, stress past month, stress past year, and stress past 3 years) and a perceived event impact latent variable (e.g., stress due to family and finances, deprivation) was better fitting than the proposed single latent variable (Table 6). Although the CFI was high (.975), the RMSEA was borderline acceptable at .076, suggesting that further improvement to this model was required. In addition, the covariance between the two latent variables was quite large (r = .85; p <.001). This high degree of relatedness between the two latent variables suggested that these constructs were not completely distinct and could be modeled as a single latent variable.

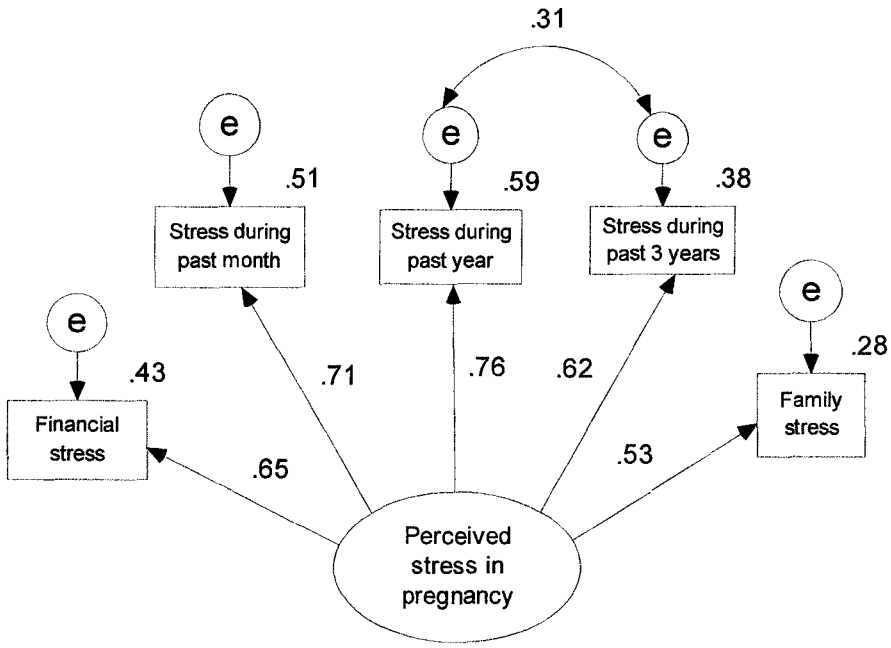
Table 6: *Summary of Analysis of Stress in Pregnancy Model* (*N* = 441)

Model Number	Model Description	X2 (df, p-value, ratio)	CFI	RMSEA (90% CI)
1	Original proposed adult model (see Figure 1) (includes deprivation).	137.6 (14, *p* <.001, 9.8)	.883	.142 (.121 - .164)
2	Two-latent variable model: (a) global perceived stress latent; and (b) perceived event impact latent.	25.0 (7, p = .001, 3.6)	.975	.076 (.046 - .110)
Amendments to Proposed Prenatal Maternal Stress Model (Model 1)				
3	Add covariances between stress past year-3 years and PSS-stress past month.	43.9 (12, *p* < .001, 3.7)	.970	.078 (.054 - .103)
4	Deletion of PSS indicator.	36.7 (8, *p* < .001, 4.6)	.962	.090 (.062 - .121)
5	Deletion of family stress indicator.	26.0 (4, *p* < .001, 6.5)	.964	.112 (.073 - .154)
6	Re-introduction of family stress indicator in model. Deletion of deprivation indicator. Note: Final adult model (see Figure 3)	3.5 (4, *p* =.47, .887)	1.00	.00 (.00 - .068)

Indicators of perceived stress in pregnancy. Because the two-factor model did not provide convincing evidence for distinct constructs, further amendments were made to the proposed (single-latent) model (see Figure 1). Based on the relatedness of the referent periods, we added two error covariances: PSS – stress during past month, and stress during past year-past 3 years (see Figure 3). Both error covariances were statistically significant and the model fit improved. While error covariances may represent theoretically substantiated improvements to a model, they can also be indicative of redundancy (Byrne, 2001). Although stress during the past year and 3 years were highly correlated ($p = .63$; $p < .001$) (Appendix K), the removal of either indicator resulted in a large deterioration of model fit, suggesting that both were important in the model (Table 6). However, the deletion of either the PSS or stress during the past month produced little change in other factor loadings or model fit. To enhance the model's parsimony, the PSS was deleted and stress during past month retained. The deletion of the family stress indicator due to its lower factor loading and R^2 value resulted in a much poorer fitting model, and it was re-entered back into the model. For similar reasons, the deprivation variable was deleted with vast improvement in model fit. The final pregnancy stress model was comprised of five indicators: stress during the past month ($r = .71$), stress during the past year ($r = .76$), stress during the past 3 years ($r = .62$), financial stress ($r = .65$), and family

stress (r = .53) (see Figure 3). All factor loadings and the covariance were statistically significant at the level of $p < .001$.

Figure 3. **Final Model of Perceived Stress in Pregnancy.**



Note. In structural equation models, the rectangles depict measured, *observed variables* (i.e., indicators) and ovals represent unmeasured *latent variables* (e.g., perceived stress in pregnancy). Latent variables represent constructs that are difficult to measure. Multiple measured indicators are used to define latent variables. "e" represents the error associated with the pathway between the latent variable and the indicator. The value above each observed variable (e.g., .43 above the financial stress indicator) is the R^2 value, the proportion of variance that is accounted for in that particular variable by the latent variable (i.e., a measure of reliability). The values on the pathways between the latent and observed variables (e.g., .65 between the latent variable and financial stress indicator) are the standardized regression coefficients and are termed "factor loadings" in measurement models. Factor loadings represent validity. In Figure 3, each factor loading is statistically significant at the $p < .001$ level.

Research Question 4: Validity and Reliability of Perceived Stress in Pregnancy Model.

In the final model, factor loadings ranged from .53 to .76, which suggests that each of the indicator variables was moderately to highly

correlated with the latent variable, perceived stress in pregnancy (see Figure 3). One way that we planned *a priori* to assess validity of the stress in pregnancy measure was to compare the magnitude, sign, and statistical significance of the PSS factor loading to the other indicators of the latent variable. As hypothesized, the PSS indicator was highly related to the latent variable ($r = .78$; $p < .001$) and, due to the same referent period, to perceived stress during the past month ($r = .67$; $p < .001$) (see Figure 1). In evaluating the construct validity of the perceived stress in pregnancy measure within the Life Course Stress and Preterm Birth model, we found that the perceived stress latent variable was significantly associated with standardized pathway coefficients of adult family cohesion ($\beta = -.25$) subjective socioeconomic position ($\beta = -.44$), and social support ($\beta = -.23$) with the hypothesized directions of effect. In terms of reliability, the R^2 values ranged from .28 to .59, indicating that the latent variable accounted for 28% to 59% of the variation in its indicator variables. The latent variable contributed the least to the family stress indicator, and the greatest to stress during the past year (see Figure 3). The greatest amount of measurement error was associated with family stress ($R^2 = .28$)

Final Integrated Model: Perceived Stress in Childhood and Pregnancy

The final, integrated model comprising both the child and pregnancy perceived stress components was very well fitting X^2 (24, N =

441) = 23.4, p =.495 with a *N/df* ratio of .976. The CFI was 1.000 and RMSEA was .000 (90% CI .000 - .038), suggesting that the model was a close fit to the sample data. All the factor loadings and error covariances were statistically significant at the level of $p < .001$, as was the pathway parameter between the child stress and pregnancy stress latent variables (r = .47). Child stress accounted for 22% of the variance in stress in pregnancy.

Discussion

Few instruments are available to measure perceived stress in either childhood or during pregnancy. Using structural equation modeling, measures of perceived stress in childhood and chronic perceived stress during pregnancy were developed and tested. To our knowledge, these are the first psychometrically-evaluated measures of their kind. Both measures have utility for research, surveillance, and clinical screening.

Model of Childhood Perceived Stress

Our analysis suggested that childhood perceived stress is unidimensional. In the absence of existing literature on the construct of childhood perceived stress, we express a caveat in that this finding is based on the specific indicators that we utilized, and an alternate set may produce a different conclusion. Conceptually, this finding implies that when women think about their childhood stress, they do so in a global manner. In other words, women do not appear to categorize childhood

perceived stress by circumstances. Rather, stress that may be related to specific circumstances is captured in a broader sense or impression of perceived stress. Of importance, other studies have found that retrospective measures are most reliable when comprised of less detailed, global assessments (Henry, Moffitt, Caspi, Langley, & Silva, 1994).

The inclusion of family stress in the model, but not financial stress, implies that women's conceptualization of childhood perceived stress is more strongly related to family stress than to financial stress. This may reflect the developmental importance that the family and family stress plays for children (Repetti, Taylor, & Seeman, 2002), or that family stress has a greater personal impact on children than the family finances. Given that over half of women in the sample indicated that their childhood family struggled financially and they experienced stress due to this circumstance (Table 3), it is unlikely that this finding is related to lack of awareness of the family's financial situation (Brewin et al., 1993).

Our analysis suggests that childhood anxiety and stress are distinct constructs that are related to a small degree, which is consistent with others who have found that anxiety is a symptomatic consequence of stress (Lazarus & Folkman, 1984; Roesch, Weiner, & Vaughn, 2002; Ridner, 2003). The incorporation of two items of the GPELS (Carpenter et al., 2004) provides a comparative component to childhood perceived stress that may tap into an important aspect of the nature of the stress and

its mechanisms underlying the stress-health relationship. The contribution of the comparative process in stress appraisal is a new concept to stress research and one that warrants further research.

We provided some evidence for the validity of our childhood stress measure by establishing relationships between our perceived childhood stress measure and objective childhood stressors. We were unable to assess whether current mood influenced recall of perceived childhood stress. Although substantial evidence suggests that mood congruent memory is an issue of short-term memory (Blaney, 1986; Matt, Vazquiz, & Campbell, 1992), little evidence exists for the impact of mood on childhood memories (Brewin et al., 1993; Maughan & Rutter, 1997; Melchert, 1998). Other studies have found that recalled perceptions of the quality of family relationships (i.e., PBI scores) were consistent across a 20-year period, suggesting that the recall of parental relationships was not influenced by life experience or mood (Wilhelm, Niven, Parker, & Hadzi-Pavlovic, 2005).

Research related to the early life environment on adult health outcomes has largely avoided the complexities of distinguishing between "actual" and "perception" by assessing the effects of *recalled* early aversive experiences. However, evidence suggests that memory is comprised of actual events, or "slices" of events, that are nuanced by sensory, perceptual, and emotional impressions (Conway, 2003), and that individuals are able to distinguish between the occurrence of actual events

and their related perceptions (Gilbert et al., 2003). Our finding that the childhood stress measure comprises primarily global indicators of perceived stress raises challenging questions regarding the importance of the impact of *perceptions* of circumstances versus the *actual* circumstances (e.g., family or financial difficulties) on health. Past studies on the validity of recalled events have largely focused on demonstrating that memories are more than perceptions (Parker et al., 1983). However, a growing body of evidence suggests that perceptions may also be uniquely important to health (Gilbert et al., 2003; Richter, Gilbert, & McEwan, 2009). Perceptions may play a different role in health outcomes than circumstances due to their ability to capture subtleties that contribute to the impression of an experience.

Model of Perceived Stress in Pregnancy

Similar to the childhood measure, our analysis suggested that prenatal maternal stress is a unidimensional construct. Because little work on measurement of perceived stress in pregnancy has been done and these few studies have used a number of different approaches to modeling stress, it is difficult to address this finding in the context of existing literature. However, perceived stress has been found to be distinct from state anxiety (i.e., an emotional response to a stimulus characterized by feelings of tension and worry) and pregnancy-related anxiety (Lobel,

1994; Roesch, Dunkel-Schetter, Woo, & Hobel, 2004), two commonly used measures of "stress".

The composition of our stress measure suggests that global perceived stress is a compilation of the assessment of past (i.e., past year, 3 years) and present (i.e., past month) stress, and therefore is reflective of a chronic appraisal of stress. In keeping with the principle of matching the temporal context of the stress measure to the etiologic process (Cohen et al., 1983), measures of chronic stress are needed to explore the preconception effects of stress on pregnancy. However, as Latendresse (2009) notes, a standardized, comprehensive measure of chronic stress is lacking in the stress-pregnancy literature and has contributed to our inability to assess relationships between chronic stress, neurohormonal markers, and adverse pregnancy outcomes.

The inclusion of perceived stress related to both family and finances in the prenatal stress model differs from the childhood model. The fact that childhood and prenatal stress models both comprised stress related to family relationship and functioning suggests that this is a consistent component of perceived stress throughout a woman's life. However, financial stress may be unique to young adulthood and, in this sample, may reflect aspects such as beginning careers, recent house/vehicle purchases, and limited savings. Of interest, Ritter et al. (2000) also found that economic stress had a higher factor loading than

family related stress in a sample of disadvantaged African-American women.

Study Strengths and Limitations

This study has several strengths. The sample was drawn from two community-based centres in different communities. Using structural equation modeling, different forms of perceived stress within and across childhood and adulthood were simultaneously compared. Our study is the first to measure stress during pregnancy in a largely Caucasian, advantaged sample. This work contributes to very small body of existing literature on stress in pregnancy, particularly chronic stress.

In evaluating the results of this study, several limitations must be considered. We cannot eliminate the possibility of selection bias by systematically excluding women from our study who did not attend pre-birth clinics at the participating hospitals. We did not measure or control for mood, and were unable to assess its impact on the retrospective perception of childhood stress. In addition, because the childhood measure encompasses earliest memories to age 16, we could not account for differing perceptions and appraisal processes that may occur as a result of developmental transitions from childhood to adolescence. On the other hand, most of the maturation of the cognitive appraisal process occurs after age 15 (Davis & Compas), and our study included women who were 16 years or older.

Implications

The epidemiology of prenatal maternal stress has immense public health benefit in its potential to reduce stress-related fetal, neonatal, child, adolescent, and adult outcomes across the life course. With further psychometric testing, the childhood (Appendix L) and pregnancy (Appendix M) perceived stress measures may be suitable for research, surveillance, and clinical screening across the life course of women. Stress-reducing intervention during pregnancy has been largely ineffective. The exploration of early life influences supports an upstream preventive approach that allows us to intervene earlier in the causal pathway than during pregnancy (Ohlsson & Shah, 2008). Surveillance plays a key role in this process. However, current approaches to perinatal surveillance in Canada do not utilize psychosocial measures, nor do they incorporate a life course perspective that considers early life exposures.

The perceived childhood and prenatal maternal stress instruments would be appropriate maternal health indicators for monitoring trends in early life stress and prenatal maternal stress, information that forms the basis of population-based intervention (Chittleborough, Baum, Taylor, & Hiller, 2006). In addition, provincial- and national-level surveillance of psychosocial health would enable exploration of the association between early and prenatal maternal stress and relatively rare perinatal outcomes, such as preterm birth, congenital anomalies, and low birth weight infants.

Both measures may also be used as part of a comprehensive psychosocial assessment used in well-woman visits and provide direction for intervention.

Conclusion

This study describes the development and initial testing of two new measures of perceived stress in childhood and during pregnancy that may have utility for research, surveillance, and clinical screening. Given that our findings, related to the validity and reliability of these measures, represent characteristics of this sample, further research is needed to psychometrically evaluate these instruments in diverse samples of pregnant women. Additional research may also explore whether these instruments are valid as prospective measures of perceived stress in non-pregnant women in order to assess their broader utility in women's health. Research assessing the criterion validity of these psychosocial measures against physiological indices as comparators is an important step in linking psychosocial and physiological responses. Finally, prospective measures of perceived stress in childhood should be developed.

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Chapter Five

Conclusions and Implications of the Doctoral Study

Introduction

The final chapter of the thesis describes the overarching conclusions of the doctoral research, and discusses clinical, educational, surveillance, policy, and research implications.

Conclusions of the Thesis Research

Development of the Life Course Stress and Preterm Birth Model

In Chapter Two, the lack of extant testable, etiologic models describing clear pathways between prenatal maternal stress and preterm birth was identified as, "the most important limitation of previous studies" (Kramer et al., 2001, p. 108). Only a handful of models have emerged in stress-preterm birth research that have integrated psychosocial, behavioural, and biological pathways. Furthermore, with very few exceptions, stress exposure has been limited to the pregnancy period, which suggests that our present "upstream" approach to preterm birth does not truly recognize that preterm birth is "more [of] a chronic process than an acute one" (Iams, 1998, p.55).

The purpose of Chapter Two was to articulate a theoretically-based, testable framework for understanding the determinants of maternal prenatal stress and preterm birth using a life course perspective. Based on Lazarus and Folkman's (1984) theory of transactional stress, the Life Course Stress and Preterm Birth Model elucidates pathways between socioeconomic and family stressors in childhood and pregnancy,

perceived stress in childhood and pregnancy, and gestational age. It also includes potential biological and behavioural influences on gestational age. We further integrated theories of health disparity by including pathways that represent both objective and subjective socioeconomic position (SEP). Given the socioeconomic disparity that is evident in preterm birth rates (Kramer et al., 2001) and the current focus in social disparity research on describing pathways between SEP and health outcomes (Lynch, Davey Smith, Kaplan, & House, 2000), it was important to describe and simultaneously compare the influences of objective versus subjective SEP. Because all previous research on prenatal maternal stress has been done in socioeconomically disadvantaged women, we do not know whether stress is socially patterned with greater prevalence observed among disadvantaged women as compared to advantaged women.

An equally key constituent of the model was the measurement component, which enabled us to conceptualize and evaluate measures of stress in both childhood and pregnancy. Finally, although other perinatal researchers have advocated for the integration of a life course approach in preterm birth research (Kramer et al., 2001; Tiedje, 2003), to our knowledge no studies or models to date have explored the influences of early life stressors on stress in pregnancy.

The overarching goals in developing and testing this model were to (a) direct clinical risk assessment, (b) guide research on preconception psychosocial influences on perinatal health, (c) direct perinatal surveillance approaches, (d) influence policy and program development to adopt a life course approach to the determinants of perinatal health, and (e) challenge existing population health notions regarding preconception and prenatal care.

Testing of the Life Course Stress and Preterm Birth Model

In Chapter Three, the results of testing and refining the Life Course Stress and Preterm Birth Model were presented. Because the preterm birth rate was too low to generate reliable pathway parameters, this discussion is limited to the primary outcome of interest, maternal stress. Much of the stress-preterm birth research has been conducted in socioeconomically disadvantaged women. However, our results demonstrate that the largely Caucasian, highly educated, advantaged women in our sample perceived notable levels of moderate to extremely high perceived stress in the previous month (38%), year (44%), 3 years (48%), and childhood (35%), which provides an important context for deriving the implications of this research.

Recalled childhood stress was a main predictor of stress in pregnancy. This finding is concerning because it suggests that childhood stress has an enduring effect, even after adjustment for other family,

socioeconomic, and support variables in childhood and adulthood. This result is also revealing in that the majority of women in this sample experienced stable childhood homes with relatively high levels of family cohesion and healthy family functioning, and where parents were married, both worked, and both had some college-level education. Given that no other studies have examined the effect of early life influences on stress in pregnancy, this evidence has potential to launch a new direction in prenatal stress research. In addition, we found that two childhood factors, subjective SEP and family cohesion, were associated with reduced childhood stress, and subsequently prenatal stress. These findings suggest that early, family-centred intervention may be a salient, upstream approach to preventing stress in childhood and pregnancy.

A high level of adult subjective SEP was significantly associated with lower stress during pregnancy, whereas adult objective SEP was not. This finding is consistent with others who have found that subjective SEP has greater predictive utility than objective SEP for psychological outcomes (Adler, Epel, Castellazzo, & Ickovics, 2000). It also provides unique understanding of stress in pregnancy, and joins a body of emerging evidence demonstrating consistent associations between subjective SEP and various health outcomes.

However, little is known about the factors that contribute to the formation of perceived social standing in adulthood, and no studies have

explored early influences; moreover, no studies have described predictors of childhood SEP. The findings of our study support and extend existing research by describing pathways that lead to subjective SEP in both pregnancy and childhood. We found that childhood subjective SEP, childhood objective SEP, adult objective SEP, and adult social support contributed to women's perceived social standing. Childhood subjective SEP was influenced by three childhood factors: objective SEP, family cohesion, and social support. Our findings are consistent with others who have found that objective SEP is one aspect that adults consider in subconsciously forming their sense of social standing (Singh-Manoux, Adler, & Marmot, 2003), and provide evidence for hypotheses that subjective social status reflects current and past socioeconomic background and family resources (Singh-Manoux et al.). As such, our study is the first to provide evidence of the formative function that childhood influences have on both childhood and adult subjective SEP, and to describe more fully the factors that contribute to adult subjective SEP.

No direct relationship between objective SEP in childhood or adulthood and maternal prenatal stress was found. Instead, objective SEP tended to have an indirect role. Childhood objective SEP was important in that it set the stage for a higher objective SEP in adulthood, a finding that is similar to others who found substantial contributions of childhood

objective SEP to adult objective SEP (Sacker, Schoon, & Bartley, 2002). Further investigation into the pathways between child and adult objective SEP is warranted.

The effects of objective SEP on subjective SEP have already been discussed. These findings are important because they indicate that it is not the absolute measure of income, education, or occupation that has an impact on either childhood or prenatal stress; rather, it is the sense of social standing that is provided by these traditional SEP indicators that influences perceived stress. Given the role that family cohesion and social support play in enhancing subjective SEP, subjective SEP would appear to be a modifiable determinant of psychosocial health.

Family cohesion in childhood had a persistent effect on reducing stress in pregnancy. Although positive in the main model, in Chapter Three we provided support for the suppression of this pathway, and the likelihood that family cohesion was negatively associated with stress in pregnancy. This small, but enduring effect casts an important light on the epidemiology of stress, and provides an early window of opportunity for stress prevention that could have implications for perinatal and chronic disease outcomes. Furthermore, family cohesion was associated with reduced stress in childhood, which subsequently influenced adult stress. The importance of the family in child and adult stress-reduction suggests that supportive, family-level intervention delivered in childhood and

adulthood may be an effective strategy for the prevention and management of stress.

Of interest, we did not find an association between perceived prenatal maternal stress and an array of demographic variables, including parity, marital status, maternal age, weeks gestation at the time of survey completion, ethnicity, or country of birth. This finding suggests that after adjustment for the other predictors in our model (e.g., family cohesion, subjective SEP, recalled childhood stress), demographic variables are not significant. This has important implications for risk screening because these factors are commonly used to characterize pregnant women who may be at greater risk for stress-related perinatal outcomes.

Measurement of Childhood and Maternal Prenatal Stress

Chapter Four describes the analysis of the stress measurement component of the Life Course Stress and Preterm Birth Model. Despite the potentially pervasive effects of prenatal maternal stress and stress in childhood, very little research has been devoted to measuring these complex constructs. In addition to providing insight into measurement of stress in childhood and pregnancy, this study provided a unique opportunity to compare the factor structure of recalled childhood stress and stress in pregnancy. Given that all existing stress measurement research in pregnancy has been conducted in disadvantaged women, this

study also provided insight into stress measurement in an advantaged sample.

Our analysis revealed that perceived stress in both childhood and pregnancy were best measured by single, latent variables. Consistent with our hypothesis, this finding suggests that pregnant women generate global assessments of current and recalled childhood perceived stress. In pregnancy, this perception reflects an assessment over an extended period (i.e., 3 years), suggesting that this measure reflects chronic stress. Given that chronic stress is understudied in pregnancy and very few measures exist, our study contributes to the conceptualization and measurement of this construct. We also found that while pregnant women considered both family and financial stress in their global perception of stress, perceptions of childhood stress tended to be constructed from family stress, but not financial stress.

Perceived stress is a notoriously difficult construct to measure, which explains why very few instruments have been developed (Sheldon Cohen, personal communication, 2006). Some foundational work has been accomplished in stress measurement in pregnancy, although it is largely atheoretical and has a strong life-event focus. Given that most life event scales are outdated renditions of scales initially developed in the 1950s and are appropriate for acute, but not chronic health outcomes (Cohen, Kessler, & Underwood Gordon, 1995), and that the trend in

stress-preterm birth studies is toward greater use of perceived stress measures, there is a need for the development of psychometrically sound perceived stress instruments. Furthermore, we found only one measure that evaluated perceived stress in childhood retrospectively, but it had been developed for a single study and was not rigorously evaluated (Carpenter et al., 2004). As such, the measures developed in this study fill a unique gap in stress measurement by providing brief instruments appropriate for childhood and pregnancy that have utility for research, clinical, and surveillance applications.

Implications of the Thesis Research

Clinical Implications

We have used the framework of the model and our findings to generate a number of potential clinical interventions that may be implemented across the life course in an effort to reduce girls' and women's stress (Table 1). Our goal is to present interventions that largely use existing points of contact with girls and women. We highlight a selection of these interventions in the following discussion.

Traditional, medically-based prenatal care begins in the late first trimester of pregnancy. It has been suggested that:

> One of the reasons that progress in improving pregnancy outcomes has slowed down, and in some cases reversed direction, is that we have failed to intervene before pregnancy to detect, manage,

> modify, and control maternal behaviors, health conditions, and risk factors that contribute to adverse maternal and infant outcomes. (Atrash, Johnson, Adams, Cordero, & Howse, p. S4)

Given that our findings suggest that perceived stress in childhood has an enduring effect on prenatal stress, we further extend the notion of pre-conception care by recommending that risk assessment, screening, and intervention encompass childhood, as well as adulthood. The fact that women in our study were advantaged suggests that a widespread, universal approach to prevention and detection is needed. With further testing, this brief childhood measure of stress may have utility in health, social, and educational settings. The prenatal stress measure may also be suitable for use in employment settings, primary care well-woman health visits, or in popular media (e.g., women's magazines). Finally, the prenatal stress measure could be used as part of a comprehensive, psychosocial assessment tool for screening for stress during pregnancy. This approach would make an important contribution by expanding current risk assessment approaches that tend to focus solely on biomedical indicators of risk.

A foundational step in reducing girls' and women's stress is to raise awareness of risk and the potential long-term impact of stress across the life course. Rather than viewing excessive stress as a normative part of life, or as a marker of a progressive career, girls and women need to

understand that it bears short- and long-term consequences and that its management is a skill to be acquired. Awareness may be raised through elementary and high school-based health and fitness classes, business-sponsored health promotion classes, primary care, and widespread media campaigns involving magazines, television, and brochures that are widely distributed. To illustrate the feasibility and potential success of this approach, the "Back to Sleep" campaign to reduce risk and rates of sudden infant death syndrome (SIDS) began with an effort to increase awareness of the association between sleep position and SIDS and subsequently to change practice. Through media, prenatal class instruction, and public health involvement, 90% of Canadian women indicated that they had enough information on SIDS and 77% reported putting their baby on their back for sleeping (Public Health Agency of Canada (PHAC), 2009).

A universally-based approach to stress prevention and detection is best served by existing infrastructures that target girls and women prior to pregnancy. This requires that we adopt innovative and intersectoral approaches involving non-traditional health care. To pose just a few examples, daycare and early childhood programs "offer an important unrecognized infrastructure for addressing the stress-related roots of social class disparities in health" (Shonkoff, Boyce, & McEwen, 2009, p. 2256). Welfare programs primarily serving single women with children

routinely offer women counseling related to enhancing self-esteem and confidence regarding employment. Rapid assessment of stress could potentially be included in these existing programs. Such programs are often linked to on-site counselors, public health departments, and nurse practitioners that could be important, cost-effective resources for stress-reducing interventions (Browne, Byrne, Roberts, & Gafni, 2001). For example, evidence suggests that stress management training is effective in improving coping and alleviating stress in children and adolescents (Hampel, Rudolph, Stachow, & Peterman, 2003) as well as adults (Surwit et al., 2002). Schools are also important sites for targeting stress in children. Primary prevention school-based educational programs (Kraag, Zeegers, Kok, Hosman, & Abu-Saad, 2006) and internet-based high-school courses (vanVliet & Andrews, 2009) have been found to reduce symptoms of stress and promote usage of healthy coping processes.

Shonkoff et al. (2009) note that the "primary care setting is arguably the most appropriate venue for a more proactive approach to the early identification and mitigation of potential causes of toxic stress in young children" (p. 2256). Nurse practitioners, public health nurses, occupational health nurses, and school nurses are strategically situated to provide early assessment and intervention of stress in children, adolescents, and women. During pregnancy, nurses who teach prenatal classes and those

employed in pre-birth clinics can also play an essential role in screening, intervention, and referral processes.

Based on our findings, enhancing family cohesion may have an important effect on reducing stress. Attachment-based interventions have been shown to be effective in augmenting family cohesion (Amaya-Jackson, & Greenberg, 2005). They aim to reduce dysfunctional parent-child interactions by enhancing parental sensitivity (i.e., warmth, predictability) and responsivity to child needs and helping parents to avoid misinterpretation of child behaviour, emotions, and signals (e.g., an infant crying) (Tarabulsy et al., 2008). Effective attachment-based interventions have: taken the form of group classes, interactive activities, videotaping, modeling, and home visits; frequently been accomplished with six sessions or less; and been delivered most successfully by health and social professionals (Tarabulsy et al.). Both preventative and interventive measures based on this approach could be delivered to women pre-conception through high school parenting classes that many adolescents take for high school credit, prenatal classes, welfare programs, early childhood centres, and well-child and well-woman health visits.

Educational Implications

The delivery of a universal approach relies, in part, on widespread education of providers within the health, education, and social systems. Providers often do not identify psychosocial issues or respond effectively

to these needs. This issue may be a consequence of inadequate education related to psychosocial care or lack of recognition of this as part of the provider role (Priest, 2006). Medical, educational, and social work-related curricula need to incorporate specific course elements designed to promote skill development in psychosocial assessment, care, and education of clients to foster self-management of stress.

Surveillance Implications

The findings of this study can inform perinatal surveillance approaches. There is a need to incorporate psychosocial indicators as part of the battery of routine perinatal surveillance indicators. This requires more than the development of a valid and reliable indicator; it also involves an expansion of the current definition of maternal morbidity. In Canada, recent progress in this direction has been accomplished through stress- and depression-related items included in the Maternity Experiences Survey (MES), the first national survey of women's pregnancy, labour and delivery experiences (PHAC, 2009). Secondly, a life course epidemiologic framework needs to be adopted in surveillance that promotes the assessment of psychosocial health across the life course. Longitudinal surveys that form the backbone of surveillance of exposures from childhood to adulthood need to incorporate psychosocial measures that can later be linked to perinatal outcomes. National

Table 1: ***Potential Interventions for Reducing Stress across the Life Course***

Level of intervention	**Intervention**
Childhood	Elementary school-based education for children on identifying stressors, identifying personal coping mechanisms, and teaching healthy coping mechanisms. Continued education into high-school (e.g., health/physical education classes, life skills classes)
	Guidance for parents from the education system, primary health care providers, and early childhood centres on identifying signs of stress in children, working with the family to identify family-level stressors, and coaching the family on interventions
	Development and use of sensitive, easy-to-administer clinical psychosocial assessment tools for children.
	Point-of-contact screening for non-clinical stress/anxiety (e.g., schools, early child centres, primary care providers, day care centres)
	Education by primary and prenatal care providers on the effects of stress on children and the importance of the parental-relationship and family-environment on socioemotional development on the child
	Widely dispersed government-supported publications on the socioemotional development of children and the role of parents and family in this process, as well as identifying symptoms of emotional distress in children with links to available resources. Potential sites for distribution may include toy stores, pharmacies and grocery stores (infant supply section), book stores, food banks, schools, malls, child care centres, family-style restaurants, banks/bank machines, primary care provider offices, dentist offices, welfare offices, early childhood centres

Adulthood	Pre-conception counseling (e.g., during healthy woman visits) related to identifying stress, stressors, and personal coping mechanisms; developing healthy coping mechanisms; importance of partner/social support, and advice regarding strength-based interventions
	Education regarding stress and its management in women's magazines and adult education programs (e.g., adults completing high-school education)
	Public health delivery of short seminars on psychosocial health in work-related settings
Pregnancy	Routine psychosocial assessments at each prenatal care visit (Hobel, 2008)
	Development of sensitive, easy-to-administer clinical psychosocial assessment tools
	Provide family-based prenatal care
	Counseling regarding strengths-based interventions
	Education by primary and prenatal care providers on the effects of stress during pregnancy and the impact of social support, particularly partner support
	Community-based prenatal care models(e.g., Centering Pregnancy) which include a social support component
	Neighbourhood-based pregnancy (and new mother) groups

commitment to surveillance of early life influences on adult health has been evident in Europe for years, and interest in North America has begun with longitudinal studies such as the National Longitudinal Survey of Children and Youth (Canada) and the National Children's Study (U.S.) that follow children to young adulthood.

Policy Implications

Numerous challenges exist in the implementation of a universal, life course-based approach to stress assessment and reduction that cannot be accomplished outside of the policy sphere. One difficulty in the seamless delivery of girls' and women's care is that services are currently provided by multiple providers across the life course. An integrated policy approach requires the integration of services across educational, social, and health sectors, and possesses elements of inter-sectoral collaboration, information flow, and service access (Browne, Kingston, Grdisa, & Markle-Reid, 2007). Such an approach cannot be accomplished without federal and provincial leadership. Some efforts have already been initiated in Ontario: the Best Start initiative that uses public schools as a central location for health and social services; family health networks that offer multiple health and social services at the same location; and services for the disadvantaged (e.g., welfare, public health, nurse practitioner) that are often grouped together at an accessible location. However, as the federally-initiated *Back to Sleep* and more recent provincial human

papilloma virus (HPV) campaigns have demonstrated, full system integration does not have to be in place before universal prevention strategies are initiated.

The provision of universally available psychosocial screening programs for girls and women necessitates the establishment of many intermediary processes that are yet to be developed. Ideally, this would represent a federal initiative of the Public Health Agency of Canada that is enacted at the provincial and municipal levels of government. Widespread screening would require the promotion of community-level capacity to support assessment, referral, and follow-up processes (Keller, Brockest, & Haresign, 2006). The evaluation of these programs would also require linkage to provincial- and national-level surveillance systems for the monitoring of trends in the prevalence of psychosocial health indicators.

Research Implications

Additional research is needed to substantiate our novel findings regarding early life influences on prenatal maternal stress. A main deterrent to our ability to enact effective prevention and intervention strategies is a lack of understanding of maternal prenatal stress and preterm birth etiology (Kramer et al., 2009). Basic and observational research should continue to define and test clearly hypothesized models of stress, preterm birth, and other adverse stress-related outcomes in order to extend our understanding of pathways that lead to these

outcomes. The complexity and chronic nature of these problems requires that researchers adopt a life course perspective that considers girls' and women's exposure to stressors across their whole lives. The implementation of an effective upstream approach to prevention of stress-related outcomes is contingent upon increasing our understanding of prenatal and early life influences.

Research should evaluate the effectiveness of individual, family-level, and population-based universal and selective preventive interventions to reduce stress in childhood and pregnancy. In children, most interventions have been treatment-related, and directed at those with extreme externalizing or internalizing behavioural symptoms of stress. Yet our study revealed that perceived childhood stress was common amongst women who characterized their homes as relatively advantaged, stable homes. Our findings are similar to those of other studies that have found that children of affluence are at risk for high stress and depression (Luthar, 2003). Therefore, greater long-term benefit in reducing population levels of stress and its disorders may be realized by directing universally-based interventions at more prevalent experiences of childhood stress, rather than solely treating those with extreme symptoms (Table 1). Given the importance of family cohesion and the context of the early environment, universal prevention inventions should include family-based approaches, and selective prevention strategies should be evaluated in children of

women who experienced high prenatal stress. Finally, preventive research should aim to use existing infrastructures such as primary health care, schools, workplaces, social services, and popular media (e.g., women's and children's magazines, internet).

In pregnancy, most stress-ameliorating intervention research has failed to reduce adverse perinatal outcomes. However, studies are few, they were conducted prior to the wave of research on preterm birth etiology, and their non-significant findings prompted researchers to focus on etiological research. In reality, the little research that has been accomplished on prenatal maternal stress as an outcome has left us with large gaps regarding prenatal stress epidemiology. Therefore, although we advocate for universal preventive intervention, we are probably still at the point where the focus needs to be on etiological research.

Etiological and intervention research cannot proceed without valid and reliable measures of psychosocial stress. In addition, community-based screening cannot advance without the availability of an appropriate screening instrument (Keller et al., 2006). As such, further psychometric testing of our proposed stress measures is warranted. In particular, additional work should focus on evaluation of these measures in socioeconomically and ethnically diverse groups pregnant women, in different regions, across different outcomes, against different measures (e.g., pregnancy-related anxiety), and in different settings (e.g., health,

social, educational sectors). These measures may also have a broader applicability for assessing early life and present perceived stress in non-pregnant women in an effort to understand early stress-related influences on other chronic diseases.

Final Words

The doctoral research project achieved all of its objectives apart from being able to assess the impact of stress on gestational age. This dilemma is not unique to our study. A recently published, large Canadian study (N = 5337) found a similar preterm birth rate to ours and reported limited the ability to detect modest associations between stress and gestational age (Kramer et al., 2009). Longitudinal, life course-based, national- and provincial-level surveillance may address some of the challenges inherent in studying this relatively rare outcome. However, our study advances our understanding of prenatal stress epidemiology, and informs future direction in this field.

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Appendix A
Indirect Pathways of Childhood SEP to Stress in Childhood and/or Pregnancy

Distal Exposure	Intermediary factors	Distal outcome	Proximal outcome
Low childhood family SEP	Poor health in childhood (Brooks-Gunn & Duncan) → poor health in adulthood (Melchior et al., 2007; van de Mheen, Stronks, van den Bon, & Mackenback, 1997)		Adult stress
	*Chronic stress; increased number of physical and psychosocial stressors in childhood (Adler & Newman, 2002; Evans & English, 2002) → increased risk of psychological issues (Rutter 1979)		Adult stress (Glei et al., 2007; Lehman et al., 2009)
	*Increased number of physical and psychosocial stressors in childhood (Evans & English, 2002)	Child stress →	Adult stress
	Prenatal maternal stress (Barker, 1997)→ physiological and functional alterations to HPA-axis in offspring	Child stress/ stress vulnerability →	Adult stress / stress vulnerability
	*Low adult SEP (Corcoran & Chaudry, 1997; Lehman et al., 2005; Melchior et al., 2007)		Adult stress (Whitehead et al., 2003)
	*Low educational achievement / low cognitive abilities/IQ (Brooks-Gunn & Duncan, 1997; Melby, Conger, Fang, Wickrama, & Conger, 2008)→ Low adult SEP (Marmot, Shipley, Brunner, & Hemingway, 2001; Melby et al.)		Adult stress
	Chronic health issues → lower IQ (Goldstein, 1990) → low adult SEP (Marmot et al., 2001)		Adult stress
	Externalizing behavioural outcomes e.g., Externalizing (aggression, fighting, acting out) (Brooks-Gunn & Duncan) → poor educational attainment (Brooks-Gunn & Duncan)→ low adult SEP		Adult stress

Distal Exposure	Intermediary factors	Distal outcome	Proximal outcome
Low childhood family SEP	*Childhood emotional problems (anxiety, social withdrawal, depression) (Brooks-Gunn & Duncan)		Adult stress
	Home environment (learning resources and toys, parental discipline) → IQ (Brooks-Gunn & Duncan) → adult SEP		Adult stress
	*Harsh parenting practices, lower quality parent-child interaction (Brooks-Gunn & Duncan; Lehman et al.; McLeod & Shanahan, 1993; Repetti et al.)	Child stress →	Adult stress (Taylor et al.)
	In adolescence: Perceived family economic hardship →reduced sense of control or mastery (Conger, Jewsbury Conger, Matthews, & Elder, 1999)	Child stress	Adult stress
	Few psychosocial resources (Seeman et al., 2008)→ expectation of negative outcomes (negativity), loss of coping ability, low optimism and high pessimism, reduced mastery, hopelessness, chronic stress (Finkelstein, Kubzansky, Capitman, & Goodman, 2007; Heinonen et al., 2006; Kristenson, Eriksen, Sluiter, Starke, & Ursin, 2004), greater threat appraisal (Chen, Langer, Raphaelson, & Matthews, 2004)	Child stress (Finklestein et al., 2007)	Adult stress (Taylor & Seeman, 1999)
	*Low childhood subjective SEP (Brown et al., 2008; Goodman, Huang, Schafer-Kalkhoff, & Adler, 2007)	Child stress (Goodman, McEwen, Dolan, Schafer-Kalkhoff, & Adler, 2005).	Adult stress
	*Low childhood subjective SEP → low adult subjective SEP		Adult stress
	*Lack of social support in childhood (e.g., less emotional support from mothers, unstable peer relationships, less parental support in nurturing peer relationships) (Dodge, Pettit, and Bates, 1994) → low self-esteem and other psychological resources (Shaw, Krause, Chatters, Connell, & Ingersoll-Dayton, 2004)	Child stress	Adult stress (Luecken, 2000; Shaw et al., 2004)

Note. Pathways with references have empiric evidence; outcomes with references have evidence linking the intermediary factors to the specific outcome; parts without references represent hypotheses that we have formed. *Represented in our model.

Appendix B

Research Ethics Board Letter of Approval

Hamilton
Health Sciences

RESEARCH ETHICS BOARD

McMaster University

REB Office, 1057 Main St. W., Hamilton, ON L8S 1B7
Telephone: 905-521-2100, Ext. 42013
Fax: 905-577-8379

April 12, 2007

PROJECT NUMBER: **07-035**

PROJECT TITLE: Past and Present Life Experiences And Pregnancy

PRINCIPAL INVESTIGATOR: **Dr. Wendy Sword**

This will acknowledge receipt of your letter dated March 20, 2007 which enclosed the outstanding signatures on the REB application along with the revised REB application, Section B, Part 1 and revised consent form. We also wish to acknowledge the minor amendments to the questionnaire, the revised study title and changes to the follow-up procedures for the above-named study. Some of these issues were raised by the Research Ethics Board at their meeting held on January 15, 2007. Based on this additional information, we wish to advise your study has been given ***final*** approval from the full REB. The submission, including the Participant Information Sheet and Consent Form, version 2 dated February 2007 was found to be acceptable on both ethical and scientific grounds. ***Please note*** attached you will find the Information Sheet/Consent forms with the REB approval affixed; all consent forms and recruitment materials used in this study must be copies of the attached materials.

We are pleased to issue final approval for the above-named study for a period of 12 months from the date of the REB meeting on January 15, 2007. Continuation beyond that date will require further review and renewal of REB approval. Any changes or amendments to the protocol or information sheet must be approved by the Research Ethics Board.

The Hamilton Health Sciences/McMaster Health Sciences Research Ethics Board operates in compliance with the ICH Guidelines Good Clinical Practice Guidelines, the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans and Division 5 Health Canada Food and Drug Regulations.

PLEASE QUOTE THE ABOVE-REFERENCE PROJECT NUMBER ON ALL FUTURE CORRESTPONDENCE

Sincerely,

Jack Holland, MD, FRCP, FRCP (C)
Chair, Research Ethics Board

Appendix C

Tri-Hospital Research Ethics Board Letter of Approval

Address correspondence to:
Michael D. Coughlin, Ph.D.
Chair, Tri-Hospital Research Ethics Board
Grand River Hospital
P.O. Box 9056
3570 King St.E.
Kitchener, ON. N2G 1G3
Tel (519) 749-4300 ext. 7348
Fax (519) 894-8329
Coughlin.michael@gmail.com

April 25, 2007

Dr. Wendy Sword
Assistant Dean (Research)
School of Nursing, HSc 3H48B
Faculty of Health Sciences
McMaster University
1200 Main Street, West
Hamilton, ON L8N 3Z5

Dear Dr. Sword:

RE: THREB #07-149 – Letter of Expedited Approval of Amendment and Revised Consent for Research Study "Past and Present Life Experiences and Pregnancy" - CMH

Study Identification Number:	***THREB #07-149***
Study Approval Date:	***February 9, 2007***
Approval Date of Amendment and Revised Consent::	***April 25, 2007***
Study Expiry Date:	***February 8, 2008***

Thank you for your letter of April 20, 2007 requesting approval of the Amendment to the above Research Project. Your request has been reviewed by members of Tri-Hospital Research Ethics Board (THREB) and approval is granted for the Amendment to the Project and the Revised Consent dated April 2007 Version #3.

NOTE: The above Study Identification Number **THREB #07-149** has been assigned to your project. Please use this number on all future correspondence.

Please call me if you have any questions.

Sincerely,

Michael D. Coughlin, Ph.D.
Chair, Tri-Hospital Research Ethics Board

Cc: Dawn Kingston, PI

Appendix D

Information Letter and Consent Form

McMaster University
Health Sciences

PARTICIPANT INFORMATION SHEET

Past and Present Life Experiences and Pregnancy

You are being invited to participate in a research study conducted by Dawn Kingston, a graduate student in the PhD nursing program at McMaster University. In order to decide whether or not you want to be a part of this research study, you should understand what is involved and the potential risks and benefits. This form gives detailed information about the research study, which will be discussed with you. Once you understand the study, you will be asked to sign this form if you wish to participate. Please take your time to make your decision.

WHY IS THIS RESEARCH BEING DONE?

This research is being done because we know little about how past and present life experiences affect pregnancy. This information will help us to better understand how health professionals can assist women before they become pregnant and during their pregnancy in order to help women have healthy pregnancies.

WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of this study is to learn about aspects of women's past and present experiences that may contribute to their health during pregnancy.

WHAT WILL MY RESPONSIBILITIES BE IF I TAKE PART IN THE STUDY?

If you volunteer to participate in this study, we will ask you to do the following things:

1. Fill out a questionnaire to provide information about your childhood and pregnancy. This questionnaire will take approximately 20 to 30 minutes to complete. You will complete the questionnaire at home.

2. Mail the questionnaire back to researchers at McMaster University in a pre-addressed stamped envelope.

3. Additional information related to your delivery will be obtained from your hospital record.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

There are no known risks to you if you take part in this study. A few questions about childhood may be uncomfortable for some women. However, you will be completing the questionnaire on your own in the privacy of yourhome.

HOW MANY PEOPLE WILL BE IN THIS STUDY?

A total of 470 women will be involved in this study.

WHAT ARE THE POSSIBLE BENEFITS FOR ME AND/OR FOR SOCIETY?

We cannot promise any personal benefits to you from your participation in this study. However, your participation will help other women in the future. The findings will help us to understand about factors that contribute to healthy pregnancies. This study also will help us better understand how to care for women before and during their pregnancy.

WHAT IF I DO NOT WANT TO TAKE PART IN THE STUDY?

It is important for you to know that you can choose not to take part in the study. Choosing not to participate in this study will in no way affect your care or services you receive.

WHAT INFORMATION WILL BE KEPT PRIVATE?

The fact that you are taking part in this study is confidential. Your information will not be shared with anyone. The questionnaire that you complete does not contain any personal identifying information, only your study number. Your hospital number will be used to access your medical chart. The consent form with your name, address, phone number and email address will be filed separately from your questionnaire. The document linking your study number, hospital number, and name will be kept in a secure place, separate from your file. All information will be securely stored in a locked file cabinet in the researcher's office. When the

results of the study are published, your name will not be used. Your identity will be anonymous and there will be no way that you can be identified.

All information collected during the study will be stored until the completion of the study and the findings have been released. Your personal information will be destroyed within one year after the study is complete.

CAN PARTICIPATION IN THE STUDY END EARLY?

You may decide at any time that you do not want to be in the study. If you withdraw from the study, this will in no way affect the quality of care you receive. However, any information you have provided will be used for the study. You may also refuse to answer any questions that you don't want to answer and still remain in the study.

WILL I BE PAID TO PARTICIPATE IN THIS STUDY?

Participation in the study is entirely voluntary and you will not receive any payment for taking part.

WILL THERE BE ANY COSTS?

Your participation in this study will not involve any additional costs to you. You will be given a self-addressed, pre-stamped envelop to mail the questionnaire to McMaster University.

IF I HAVE ANY QUESTIONS OR PROBLEMS, WHOM CAN I CALL?

If you have any questions about the research now or later, please contact Dawn Kingston at (519) 446-3356 or Dr. Wendy Sword at McMaster University, 905-525-9140 ext 22307.

If you have any questions regarding your rights as a research participant, you may contact the Office of the Chair of the Hamilton Health Sciences/Faculty of Health Sciences Research Ethics Board at 905-521-2100, ext. 42013.

There is a consent form attached to this information sheet. By signing the consent form, you are agreeing to take part in the study. We hope that you will participate because it is very important to understand about the factors that contribute to healthy pregnancies.

CONSENT STATEMENT

I understand that I am being asked to take part in a research study about how past and present experiences affect pregnancy. I have received a copy of the Participant Information Sheet and have read it thoroughly. I have had the opportunity to ask questions, and all of my questions have been answered to my satisfaction.

I understand that:

- I will be asked to fill out a 20-30 minute questionnaire to provide background information about myself.
- I may receive a reminder by mail (or email) encouraging me to send my completed questionnaire to McMaster University.
- I am allowing the researchers to obtain information related to this delivery and my baby's health from my hospital record
- I will be asked questions about circumstances during my childhood, my recent past, and the present.
- I will be asked questions about my pregnancy.
- All information will be kept confidential.
- I will in no way be identified in any reports of the study.
- My participation is entirely voluntary.
- I can refuse to answer specific questions or withdraw from the study even after I agree to participate.
- If I do not want to answer a question or decide to withdraw from the study, this will not affect any services that I might receive in the hospital or in the community.
- If I decide to withdraw from the study, any information I have provided can be used.
- I will not benefit in any direct way as a result of my participation.
- I will receive a signed copy of this form.

I agree to participate in the study titled "*Past and Present Life Experiences and Pregnancy*" and understand that I will receive a signed copy of this form.

I understand that I may be contacted by the researcher for follow-up purposes by mail or email.

_____
Name of Participant

_____ _____
Signature of Participant Date

Address:_____
Street number Street name Apartment number

_____
City/town Postal Code

Email address (optional):
_____

Consent form administered and explained in person by:

_____ _____
Name and title (please print) Date

_____ _____
Principal Investigator Signature Date

Appendix E

Questionnaire

Past and Present Life Experiences and Pregnancy

There is little information available about how past and present life experiences can affect women in pregnancy. This study will look at circumstances in your life before you became pregnant, and during your pregnancy. Your participation in this study will help us to better understand how health professionals can assist women *before* they become pregnant and *during* their pregnancy in order to help women have healthy pregnancies.

Your participation in this study will involve:

- Filling in this 20-30 minute questionnaire at home and mailing it back to researchers at McMaster University using a self-addressed, pre-stamped envelope

Your participation is voluntary and all information will remain confidential. Answers will be combined together so that no individual response can be identified. Please keep in mind that there is no right or wrong answer.

We will be happy to answer any questions that you have about the study. Please ask your nurse in the pre-birth clinic, or contact the primary investigator, Dawn Kingston, by email at kingstda@mcmaster.ca or by phone at 519-446-3356. If you are calling long distance, let us know and we will phone you back. Thank you for agreeing to participate in this important study about how to help women have healthy pregnancies.

Important: Please mail this questionnaire back within 1 week after your visit to the pre-birth clinic.

Before you begin...

This questionnaire has 3 main parts:

- Part A (the white part) asks questions about your pregnancy;
- Part B (the blue part) asks questions about your childhood, and
- Part C (the green part) asks questions about your current situation.

You will notice that some of the same questions are asked more than once, but refer to different times in your life. For example, the same question may be asked about your childhood family and again about your current family.

Date on which you are completing this questionnaire:_____

Month/Day/Year

Part A: Your Pregnancy

The following questions ask about your current and previous pregnancies.

Q1. Is this your first pregnancy? (Circle ONE number)

1. Yes
2. No

Q2. How many weeks pregnant are you as of today? (Enter number)

_____ weeks

Q3. What is your due date? (e.g., August 20, 2007) (Enter date)

_____/_____/_____
(month, day, year)

Q4. Have you ever had a premature baby (i.e., a baby who was born before the 37th week of pregnancy)? (Circle ONE number)

1. Yes
2. No

Q5. On average, how many cigarettes do you currently smoke each day? (Circle ONE number)

1. None – I do not smoke cigarettes
2. 1-5 cigarettes per day
3. 6-10 cigarettes per day
4. >10 cigarettes per day

Q6. On average, how many cigarettes did you smoke just before you became pregnant? (Circle ONE number)

1. None – I did not smoke cigarettes
2. 1-5 cigarettes per day
3. 6-10 cigarettes per day
4. >10 cigarettes per day

Q7. Would you describe your daily routine as physically demanding (e.g., the work you do is physically hard or tiring, or you stand for long periods in your work)?
(Circle ONE number)

1. Yes
2. No

Part B: Your Childhood

The following questions ask about your childhood home, from the time you were born until you were 16 years old.

Some questions ask about your "father". "Father" may be your biological father, or may be a "father-figure" who helped to raise you during your childhood, such as a step-father, or your mother's partner.

Some questions ask about your "mother". "Mother" may be your biological mother, or a "mother-figure" who help to raise you during your childhood, such as a step-mother, or your father's partner.

Your Childhood Home

Q8. For *most* of your childhood (until you were 16 years of age), what was the marital status of your parent or parents that you lived with? (Circle ONE number)

1. Married
2. Lived common-law
3. Widowed
4. Separated
5. Divorced
6. Single, never married

Questions 9 to 12 ask about your mother's (mother-figure's) employment situation during your childhood (up until age 16). If you did not have a mother (or mother-figure), go to Question 13.

These questions refer to your mother's (mother-figure's) main job. If your mother (mother-figure) never worked for pay, please go to Question 13.

Q9. Did your mother (mother-figure) work as an employee, or was she self-employed? (Circle ONE number)

1. Employee → **Go to Q10.**
2. Self-employed and she had employees working for her → **Go to Q10.**
3. Self-employed/freelance *without* employees → **Go to Q12.**

Q10. If your mother was an *employee*, indicate below how many people worked for her employer at the place where she worked? (Circle ONE number). **Go to question 11 when you have completed this question.**

If your mother was *self-employed*, indicate below how many people she employed. (Circle ONE number)**. Go to question 12 when you have completed this question.**

1. 1-24
2. 25 or more

Q11. Did your mother (mother-figure) supervise any other employees (A supervisor or foreman is responsible for overseeing the work of other employees on a day-to-day basis)? (Circle ONE number)

1. Yes
2. No

Q12. What *best* describes the sort of work your mother (mother-figure) did? (Circle ONE number)

1. Modern professional occupation (*e.g., teacher, nurse, physiotherapist, social worker, welfare officer, artist, musician, police officer – sergeant or above, software designer)*

2. Clerical and intermediate occupation (*e.g., secretary, personal assistant, clerical worker, office clerk, call centre agent, personal support worker*)

3. Senior manager or administrator (*e.g., usually responsible for planning, organizing, and coordinating work and for finance, including financial manager, chief executive*)

4. Technical and craft occupation (*e.g., motor mechanic, fitter, inspector, plumber, printer, tool maker, electrician, gardener, train driver)*

5. Semi-routine manual and service occupation (*e.g., postal worker, machine operative, security guard, caretaker, farm worker, catering assistant, receptionist, sales assistant)*

6. Routine manual and service occupation (*e.g., driver, cleaner, porter, packer, sewing machinist, messenger, labourer, waiter/waitress, bar staff)*

7. Middle or junior manager (*e.g., office manager, retail manager, bank manager, restaurant manager, warehouse manager, bar/pub owner/manager)*

8. Traditional professional occupation (*e.g., accountant, lawyer, medical practitioner, scientist, civil/mechanical engineer)*

This section has a number of questions that ask about your father's (father-figure's) employment situation during your childhood (up until age 16). If you did not have a father (or father-figure), go to Question 17.

The following questions refer to your father's (father-figure's) main job. If your father (father-figure) never worked for pay, please go to Question 17.

Q13. Did your father (father-figure) work as an employee, or was he self-employed? (Circle ONE number)

1 Employee → **Go to Q14.**
2 Self-employed and he had employees working for him → **Go to Q14.**
3 Self-employed/freelance *without* employees → **Go to Q16.**

Q14. If your father (father-figure) was an *employee*, indicate below many people worked for his employer at the place where he worked? (Circle ONE number). **Go to question 15 when you have completed this question.**

If your father (father-figure) was *self-employed*, indicate below how many people he employed. (Circle ONE number)**. Go to question 16 when you have completed this question.**

1 1-24
2 25 or more

Q15. Did your father (father-figure) supervise any other employees (A supervisor or foreman is responsible for overseeing the work of other employees on a day-to-day basis)? (Circle ONE number)

1. Yes
2. No

Q16. What *best* describes the sort of work your father (father-figure) did?
(Circle ONE number)

1 Modern professional occupation (*e.g., teacher, nurse, physiotherapist, social worker, welfare officer, artist, musician, police officer – sergeant or above, software designer)*

2 Clerical and intermediate occupation (*e.g., secretary, personal assistant, clerical worker, office clerk, call centre agent, personal support worker*)

3 Senior manager or administrator (*e.g., usually responsible for planning, organizing, and coordinating work and for finance, including financial manager, chief executive*)

4 Technical and craft occupation (*e.g., motor mechanic, fitter, inspector, plumber, printer, tool maker, electrician, gardener, train driver)*

5 Semi-routine manual and service occupation (*e.g., postal worker, machine operative, security guard, caretaker, farm worker, catering assistant, receptionist, sales assistant)*

6 Routine manual and service occupation (*e.g., driver, cleaner, porter, packer, sewing machinist, messenger, labourer, waiter/waitress, bar staff)*

7 Middle or junior manager (*e.g., office manager, retail manager, bank manager, restaurant manager, warehouse manager, bar/pub owner/manager)*

8 Traditional professional occupation (*e.g., accountant, lawyer, medical practitioner, scientist, civil/mechanical engineer)*

Q17a. During your childhood (up to age 16), how often was your mother without paid work (e.g., due to unemployment, illness, or for other reasons)? (Circle ONE number)

1. All of the time
2. Most of the time
3. Some of the time
4. Rarely
5. Never
6. My mother did not work for pay

Q17b. During your childhood (up to age 16), how often was your father without paid work (e.g., due to unemployment, illness, or for other reasons)? (Circle ONE number)

1. All of the time
2. Most of the time
3. Some of the time
4. Rarely
5. Never
6. My father did not work for pay

Q18. When you were a child (up to age 16), what was the highest level of education that your mother (or mother-figure) had? (Circle ONE number)

1. elementary school or less
2. some high school
3. completed high school
4. some community college or technical school
5. completed community college or technical school
6. some university
7. completed bachelor's degree
8. graduate degree
9. Does not apply – I did not have a mother (or mother-figure)

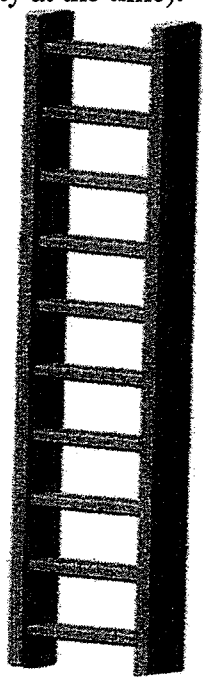
Q19. When you were a child (up to age 16), what was the highest level of education that your father (or father-figure) had? (Circle ONE number)

1. elementary school or less
2. some high school
3. completed high school
4. some community college or technical school
5. completed community college or technical school
6. some university
7. completed bachelor's degree
8. graduate degree
9. Does not apply – I did not have a father (or father-figure)

Q20. Think of the ladder below are representing where people stand in their communities.

People define community in different ways; please define it in whatever way is most meaningful to you. At the **top** of the ladder are the people who have the highest standing in their community. At the **bottom** are the people who have the lowest standing in their community.

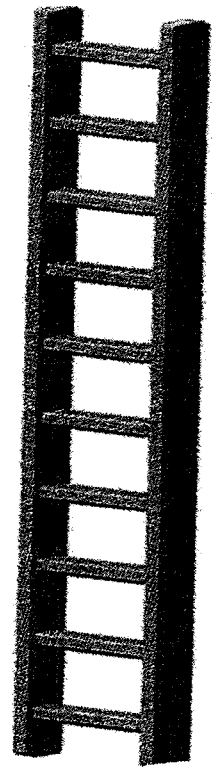
When you were a child (up to age 16), where would you have placed your family on this ladder? (Place a large "**X**" on the *rung* of the ladder where you feel that your family was when you were a child, compared to other people in your community at the time).



Q21. Think of the ladder below as representing where people stand in Ontario.

At the **top of the ladder** are the people who are the best off – those who have the most money, the most education and the most respected jobs. At the **bottom** are the people who are the worst off – those who have the least money, least education, and the least respected jobs or no jobs. The higher you are on this ladder, the better off you are (e.g., the closer you are to the very top); the lower you are, the worse off you are (e.g., the closer you are to the very bottom).

> **When you were a child (up to age 16), where would you have placed your family on this ladder?** (Place a large "**X**" on the *rung* of the ladder where you feel that your family was when you were a child, compared to other people in Ontario at the time).



Q22a. Did your family *own* the home (e.g., house, townhouse, condominium) where you lived for most of your childhood? (Circle ONE number)

1. Yes
2. No

Q22b. How stressful was this situation for you as a child? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. **Moderately stressful**
4. Mildly stressful
5. Not at all stressful

Q23a. Did your family receive welfare benefits? (Circle ONE number)

1. Yes, for most of my childhood
2. Yes, for a brief period(s) during my childhood
3. No, we did not receive welfare benefits at all → **Go to Q24**.

Q23b. How stressful was this situation for you as a child? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. **Moderately stressful**
4. Mildly stressful
5. Not at all stressful

Q24a. When you were a child (up to age 16), did your family ever experience a change in its financial situation (e.g., parents divorced or separated, one or more parents lost their job, parent remarried, money was left to the family). (Circle ONE number)

1. Yes, a financial change that improved our family's financial situation
2. Yes, a financial change that worsened our family's financial situation
3. No → **Go to Q25.**

Q24b. How did you feel that this event affected your family's financial situation? (Circle ONE number)

1. Things became much better → **Go to Q25.**
2. Things became better → **Go to Q25.**
3. Things stayed pretty much the same → **Go to Q25.**
4. Things became worse
5. Things became much worse

Q24c. If things became *worse* or *much worse*, how stressful was this situation for you as a child (up to age 16)? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. **Moderately stressful**
4. Mildly stressful
5. Not at all stressful

Q25a. During your childhood (up to age 16), how often did you feel that your family did *not have enough* money for things that your family *needed* (e.g., groceries, clothes, medications)? (Circle ONE number)

1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time → **Go to Q26.**

Q25b, How stressful was this situation for you as a child (up to age 16)? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. **Moderately stressful**
4. Mildly stressful
5. Not at all stressful

Q26a. During your childhood (up to age 16), how often did you feel that your family did *not have* enough money to buy "unnecessary" or "extra" things (e.g., toys, music lessons, organized sports, entertainment, travel)? (Circle ONE number)

1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time → **Go to Q27.**

Q26b. How stressful was this situation for you as a child (up to age 16)? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. **Moderately stressful**
4. Mildly stressful
5. Not at all stressful

Q27a. During your childhood (up to age 16), how often did you feel that your family was struggling financially? (Circle ONE number)

1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time → **Go to Q28.**

Q27b. How stressful was this situation for you as a child (up to age 16)? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. **Moderately stressful**
4. Mildly stressful
5. Not at all stressful

Sometimes when people think of their childhood, they feel that they were "disadvantaged", or "deprived" in some way, or that they were missing something that they needed compared to other people. People may feel this way for different reasons. For example, a person may feel "deprived" because he/she felt that his/her family did not have enough money, or because his/her family was troubled in some way.

Q28a. Overall, how "deprived" did you feel as a child (up to age 16)? (Circle ONE number)

1. Extremely deprived
2. Very deprived
3. **Somewhat deprived**
4. A little deprived
5. Not at all deprived → **Go to Q29.**

Q28b. What made you feel most deprived as a child (up to age 16)? (Circle ALL that apply)

1. My family/ my home life
2. My family's financial situation
3. Other (please specify):_____

_____

_____

Your Childhood Family

In this section, we ask about what your immediate family was like when you were a child (up to age 16). The following statements describe situations that are commonly found in families. For each question, please circle the number that best describes your family when you were a child.

Q29. The following statements are about how families work together. For *each* statement, please circle the ONE number that best describes your childhood family (up to age 16).

	Strongly disagree	Disagree	Agree	Strongly agree
Planning family activities was difficult because we misunderstood each other (e.g., because we misunderstood what each other wanted, we did not communicate well with each other).	1	2	3	4
In times of crisis, we turned to each other for support.	1	2	3	4
We could not talk to each other about the sadness we felt.	1	2	3	4
Individuals *were* accepted for who they were.	1	2	3	4
We avoided discussing our fears and concerns.	1	2	3	4
We expressed feelings to each other.	1	2	3	4
There were lots of bad feelings in our family.	1	2	3	4
We *felt* accepted for who we were.	1	2	3	4
Making decisions was a problem for our family.	1	2	3	4
We were able to make decisions about how to solve problems.	1	2	3	4
We didn't get along well together.	1	2	3	4
We confided in each other.	1	2	3	4

Q30. The following statements are about relationships with those in your immediate family when you were a child up to the age of 16. For *each* of the following statements, please circle the ONE number that best describes your childhood family's relationships.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Family members asked each other for help.	1	2	3	4	5
We approved of each other's friends.	1	2	3	4	5
We liked to do things with just family.	1	2	3	4	5
Family members felt closer to family than others.	1	2	3	4	5
Family members spent free time together.	1	2	3	4	5
Family members felt very close.	1	2	3	4	5
When family got together, everyone was present.	1	2	3	4	5
We could easily think of things to do as a family.	1	2	3	4	5
Family members consulted other family members on their decisions.	1	2	3	4	5
Family togetherness was important.	1	2	3	4	5

Q31. This question lists various attitudes and behaviours of parents.

As you remember your "*mother*" *(biological mother* or mother-*figure who helped to raise you)* in your first 16 years, circle ONE number that best describes her in each statement. If you did not have a mother (or mother-figure) during your childhood, go to question 32.

My mother....	*Strongly Agree*	*Agree*	*Disagree*	*Strongly Disagree*
Spoke to me in a warm and friendly voice	1	2	3	4
Did not help me as much as I needed	1	2	3	4
Let me do those things I liked doing	1	2	3	4
Seemed emotionally cold to me	1	2	3	4
Appeared to understand my problems and worries	1	2	3	4
Was affectionate to me	1	2	3	4
Liked me to make my own decisions	1	2	3	4
Did not want me to grow up	1	2	3	4
Tried to control everything I did	1	2	3	4
Invaded my privacy	1	2	3	4
Enjoyed talking things over with me	1	2	3	4
Frequently smiled at me	1	2	3	4
Tended to baby me	1	2	3	4

Did not seem to understand what I needed or wanted	1	2	3	4
Let me decide things for myself	1	2	3	4
Made me feel I wasn't wanted	1	2	3	4
Could make me feel better when I was upset	1	2	3	4
Did not talk with me very much	1	2	3	4
Tried to make me feel dependent on her	1	2	3	4
Felt I could not look after myself unless she was around	1	2	3	4
Gave me as much freedom as I wanted	1	2	3	4
Let me go out as often as I wanted	1	2	3	4
Was overprotective of me	1	2	3	4
Did not praise me	1	2	3	4
Let me dress in any way I pleased	1	2	3	4

Q32. This question lists various attitudes and behaviours of parents.

As you remember your *"father" (biological father* or a *father-figure who helped to raise you)* in your first 16 years, circle ONE number that best describes him in each statement. If you did not have a father (or father-figure) during your childhood, go to question 33.

My father....	*Strongly Agree*	*Agree*	*Disagree*	*Strongly Disagree*
Spoke to me in a warm and friendly voice	1	2	3	4
Did not help me as much as I needed	1	2	3	4
Let me do those things I liked doing	1	2	3	4
Seemed emotionally cold to me	1	2	3	4
Appeared to understand my problems and worries	1	2	3	4
Was affectionate to me	1	2	3	4
Liked me to make my own decisions	1	2	3	4
Did not want me to grow up	1	2	3	4
Tried to control everything I did	1	2	3	4
Invaded my privacy	1	2	3	4
Enjoyed talking things over with me	1	2	3	4
Frequently smiled at me	1	2	3	4
Tended to baby me	1	2	3	4

Did not seem to understand what I needed or wanted	1	2	3	4
Let me decide things for myself	1	2	3	4
Made me feel I wasn't wanted	1	2	3	4
Could make me feel better when I was upset	1	2	3	4
Did not talk with me very much	1	2	3	4
Tried to make me feel dependent on him	1	2	3	4
Felt I could not look after myself unless he was around	1	2	3	4
Gave me as much freedom as I wanted	1	2	3	4
Let me go out as often as I wanted	1	2	3	4
Was overprotective of me	1	2	3	4
Did not praise me	1	2	3	4
Let me dress in any way I pleased	1	2	3	4

Q33. Overall, how would you describe the amount of stress that you experienced as a child (up to age 16) because of your family (e.g., family relationships, how your family worked together)? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. Moderately stressful
4. Mildly stressful
5. Not at all stressful

Childhood Feelings

Q34. Below is a list of statements that describe how children may feel. Please answer these questions according to how you generally felt during your childhood (up to age 16). For each statement, circle the ONE number that best applies to you when you were a child.

	Not True	*Somewhat True*	*True*
I worried about other people liking me.	1	2	3
I was nervous.	1	2	3
I worried about being as good as other kids.	1	2	3
I worried about things working out for me.	1	2	3
I was a worrier.	1	2	3
People told me that I worried too much.	1	2	3
I worried about what was going to happen in the future.	1	2	3
I worried about how well I did things.	1	2	3
I worried about things that had already happened.	1	2	3

Q35. This question asks about 2 separate time periods during your childhood.

Q35a. How stressful do you feel your life was, compared to that of other children, *when you were in elementary school (ie., between the ages of 6 and 12).* (Circle ONE number)

1. Essentially stress free
2. Less stressful than most kids
3. About average
4. More stressful that most kids
5. Extremely stressful

Q35b. How stressful do you feel your life was, compared to that of other children, during your *early teenage years (i.e. age 13 – 16 years).* (Circle ONE number)

1. Essentially stress free
2. Less stressful than most kids
3. About average
4. More stressful that most kids
5. Extremely stressful

Q36. Overall, how stressful was your childhood (up to age 16)? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. Moderately stressful
4. Mildly stressful
5. Not at all stressful

Childhood Support

Q37. In this question, there are a number of statements about how much help teachers, classmates, and close friend(s) gave you during your childhood (up to age 16). Please circle the number that best describes how often teachers/coaches, classmates, and close friends helped you. When you are thinking about your past teachers, and all close friends, or you may choose to think about a particular teacher, or close friend. Read each statement, and circle the ONE number that best describes how often the person(s) helped you.

My teacher(s)/coach(es)...	Never	Very rarely	Rarely	Occasionally	Very frequently	Always
...cared about me.	1	2	3	4	5	6
... treated me fairly.	1	2	3	4	5	6
...made it okay to ask questions.	1	2	3	4	5	6
... explained things that I didn't understand.	1	2	3	4	5	6
... showed me how to do things.	1	2	3	4	5	6
... helped me solve problems by giving me information.	1	2	3	4	5	6
... told me I did a good job when I did something well.	1	2	3	4	5	6
... nicely told me when I made mistakes.	1	2	3	4	5	6
... told me how well I did on tasks.	1	2	3	4	5	6
... made sure I had what I needed for school.	1	2	3	4	5	6

… took time to help me learn to do something well	1	2	3	4	5	6
… spent time with me when I needed help.	1	2	3	4	5	6
My classmates….	*Never*	*Very rarely*	*Rarely*	*Occasionally*	*Very frequently*	*Always*
… treated me nicely.	1	2	3	4	5	6
… liked most of my ideas and opinions.	1	2	3	4	5	6
… paid attention to me.	1	2	3	4	5	6
… gave me ideas when I didn't know what to do.	1	2	3	4	5	6
…gave me information so I could learn new things.	1	2	3	4	5	6
… gave me good advice.	1	2	3	4	5	6
My classmates continued….	*Never*	*Very rarely*	*Rarely*	*Occasionally*	*Very frequently*	*Always*
… told me I did a good job when I did something well.	1	2	3	4	5	6
… nicely told me when I made mistakes.	1	2	3	4	5	6
… noticed when I had worked hard.	1	2	3	4	5	6
… asked me to join activities.	1	2	3	4	5	6
… spent time doing things with me.	1	2	3	4	5	6

… helped me with projects in class.	1	2	3	4	5	6
My close friend(s)…	*Never*	*Very rarely*	*Rarely*	*Occasionally*	*Very frequently*	*Always*
… understood my feelings.	1	2	3	4	5	6
… stuck up for me if others were treating me badly.	1	2	3	4	5	6
… helped me when I was lonely.	1	2	3	4	5	6
… gave me ideas when I didn't know what to do.	1	2	3	4	5	6
… gave me good advice.	1	2	3	4	5	6
… explained things that I didn't understand.	1	2	3	4	5	6
… told me he or she liked what I did	1	2	3	4	5	6
… nicely told me when I made mistakes.	1	2	3	4	5	6
… nicely told me the truth about how I did on things.	1	2	3	4	5	6
… helped me when I needed it.	1	2	3	4	5	6
…shared his or her things with me.	1	2	3	4	5	6
… took time to help me solve my problems.	1	2	3	4	5	6

Q38. During your childhood (up to age 16), how important to you was the support that your family gave you? (Circle ONE number)

1. Extremely important
2. Very important
3. Somewhat important
4. Not very important
5. Not at all important

Q39. During your childhood (up to age 16), how important to you was the support that your teachers and/or coaches gave you? (Circle ONE number)

1. Extremely important
2. Very important
3. Somewhat important
4. Not very important
5. Not at all important

Q40. During your childhood (up to age 16), how important to you was the support that your classmates gave you? (Circle ONE number)

1. Extremely important
2. Very important
3. Somewhat important
4. Not very important
5. Not at all important

Q41. During your childhood (up to age 16), how important to you was the support that your close friend(s) gave you? (Circle ONE number.)

1. Extremely important
2. Very important
3. Somewhat important
4. Not very important
5. Not at all important

Part C: Current Life

Part C of the questionnaire asks about what life is like for you at this point in time, and how you manage your current circumstances.

Family Economic Situation

In this section, we ask about your family's current and recent economic situation. In this section, "family" means your immediate family (e.g., including your spouse/partner, children).

The following questions refer to your current main job, or (if you are not working now) to your last main job. Please circle ONE number only per question. If you have never worked for pay, please go to Question 46.

Q42. Do (did) you work as an employee, or are/were you self-employed?
(Circle ONE number)

1. Employee → **Go to Q43**
2. Self-employed and you have employees working for you → **Go to Q43**
3. Self-employed/freelance *without* employees → **Go to Q45**

Q43. If you are/were an employee, indicate below many people work for your employer at the place where you work/worked? (Circle ONE number). **Go to question 44 when you have completed this question.**

If you are/were self-employed, indicate below how many people you employ(ed). (Circle ONE number). **Go to question 45 when you have completed this question.**

1. 1-24
2. 25 or more

Q44. Do/did you supervise any other employees (A supervisor or foreman is responsible for overseeing the work of other employees on a day-to-day basis)? (Circle ONE number)

1. Yes
2. No

Q45. What *best* describes the sort of work you do/did (Circle ONE number)?

1 Modern professional occupation (***e.g., teacher, nurse, physiotherapist, social worker, welfare officer, artist, musician, police officer – sergeant or above, software designer)***

2 Clerical and intermediate occupation (*e.g., secretary, personal assistant, clerical worker, office clerk, call centre agent, personal support worker*)

3 Senior manager or administrator (*e.g., usually responsible for planning, organizing, and coordinating work and for finance, including financial manager, chief executive*)

4 Technical and craft occupation (*e.g., motor mechanic, fitter, inspector, plumber, printer, tool maker, electrician, gardener, train driver)*

5 Semi-routine manual and service occupation (*e.g., postal worker, machine operative, security guard, caretaker, farm worker, catering assistant, receptionist, sales assistant)*

6 Routine manual and service occupation (*e.g., driver, cleaner, porter, packer, sewing machinist, messenger, labourer, waiter/waitress, bar staff)*

7 Middle or junior manager (*e.g., office manager, retail manager, bank manager, restaurant manager, warehouse manager, bar/pub owner/manager)*

8 Traditional professional occupation (*e.g., accountant, lawyer, medical practitioner, scientist, civil/mechanical engineer)*

This section has a number of questions that ask about your partner's current main job. If you do not have a partner, go to Question 50.

The following questions refer to your partner's current main job, or (if not working now) to his last main job. Please circle ONE number only per question. If he has never worked for pay, please go to Question 50.

Q46. Does/did your partner work as an employee, or is/was he self-employed? (Circle ONE number)

1. Employee → **Go to Q47**
2. Self-employed and had employees working for him → **Go to Q47**
3. Self-employed/freelance *without* employees → **Go to Q49**

Q47. If your partner is/was an employee, indicate below many people worked for his employer at the place where he works/worked? (Circle ONE number). **Go to question 48 when you have completed this question.**

If your partner is/was self-employed, indicate below how many people he employs/employed. (Circle ONE number)**. Go to question 49 when you have completed this question.**

1. 1-24
2. 25 or more

Q48. Does/did your partner supervise any other employees (A supervisor or foreman is responsible for overseeing the work of other employees on a day-to-day basis)? (Circle ONE number)

1. Yes
2. No

Q49. What *best* describes the sort of work your partner does/did?
(Circle ONE number)

1 Modern professional occupation (***e.g., teacher, nurse, physiotherapist, social worker, welfare officer, artist, musician, police officer – sergeant or above, software designer)***

2 Clerical and intermediate occupation (*e.g., secretary, personal assistant, clerical worker, office clerk, call centre agent, personal support worker*)

3 Senior manager or administrator (*e.g., usually responsible for planning, organizing, and coordinating work and for finance, including financial manager, chief executive*)

4 Technical and craft occupation (*e.g., motor mechanic, fitter, inspector, plumber, printer, tool maker, electrician, gardener, train driver)*

5 Semi-routine manual and service occupation (*e.g., postal worker, machine operative, security guard, caretaker, farm worker, catering assistant, receptionist, sales assistant)*

6 Routine manual and service occupation (*e.g., driver, cleaner, porter, packer, sewing machinist, messenger, labourer, waiter/waitress, bar staff)*

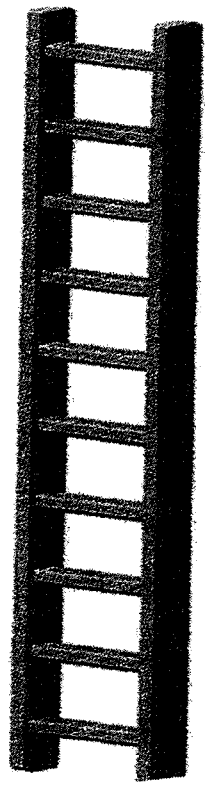
7 Middle or junior manager (*e.g., office manager, retail manager, bank manager, restaurant manager, warehouse manager, bar/pub owner/manager)*

8 Traditional professional occupation (*e.g., accountant, lawyer, medical practitioner, scientist, civil/mechanical engineer)*

Q50. Think of the ladder below are representing where people stand in their communities.

People define community in different ways; please define it in whatever way is most meaningful to you. At the **top** of the ladder are the people who have the highest standing in their community. At the **bottom** are the people who have the lowest standing in their community.

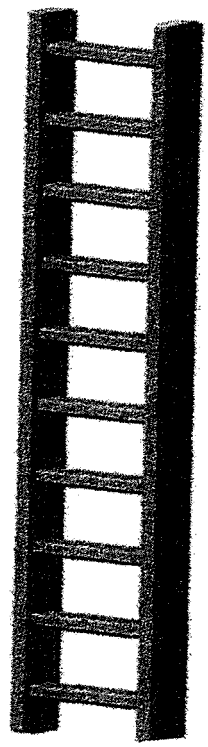
Where would you place yourself on this ladder? (Place a large "**X**" on the rung of the ladder where you feel you are right now, compared to other people in your community)



Q51. Think of the ladder below as representing where people stand in Ontario

At the **top of the ladder** are the people who are the best off – those who have the most money, the most education and the most respected jobs. At the **bottom** are the people who are the worst off – those who have the least money, least education, and the least respected jobs or no jobs. The higher you are on this ladder, the better off you are (e.g., the closer you are to the very top); the lower you are, the worse off you are (e.g., the closer you are to the very bottom).

Where would you place yourself on this ladder? (Place a large "**X**" on the rung of the ladder where you feel you are right now, compared to other people in Ontario).



Q52a. Does your family *own* the home (house, townhouse, condominium) that you live in? (Circle ONE number)

1. Yes
2. No

Q52b. How stressful is this situation for you? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. Moderately stressful
4. Mildly stressful
5. Not at all stressful

Q53a. Have you collected unemployment or disability benefits during the past year? (Circle ONE number)

1. Yes
2. No → **Go to Q54.**

Q53b. For how long did you collect these benefits? (Circle ONE number)

1. <3 months
2. 3-6 months
3. >6 months

Q53c. How stressful was this situation for you? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. Moderately stressful
4. Mildly stressful
5. Not at all stressful

Q54a. Has your spouse/partner collected unemployment or disability benefits during the past year? (Circle ONE number)

1. Yes
2. No → **Go to Q55.**

Q54b. For how long did your spouse/partner collect these benefits? (Circle ONE number)

1. <3 months
2. 3-6 months
3. >6 months

Q54c. How stressful was this situation for *you*? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. Moderately stressful
4. Mildly stressful
5. Not at all stressful

Q55a. During the past year, have you or your partner/spouse received welfare benefits? (Circle ONE number).

1. Yes
2. No → **Go to Q56.**

Q55b. How stressful has this situation been for you? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. Moderately stressful
4. Mildly stressful
5. Not at all stressful

Q56a. During the past year, how often have you felt that your family has *not had* enough money for things that your family needed (e.g., groceries, clothes, medications)? (Circle ONE number)

1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time → **Go to Q57.**

Q56b. How stressful has this situation been for you? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. Moderately stressful
4. Mildly stressful
5. Not at all stressful

Q57a. During the past year, how often have you felt that your family has not had enough money for "*unnecessary*" or "*extra*" things that you would have liked (e.g., toys for children, household decorations, vacation)? (Circle ONE number)

1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time → **Go to Q58.**

Q57b. How stressful has this situation been for you? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. Moderately stressful
4. Mildly stressful
5. Not at all stressful

Q58a. During the past year, how much do you feel that your family has struggled financially? (Circle ONE number)

1. A great deal
2. Quite a bit
3. A little
4. None → **Go to Q59**.

Q58b. How stressful has this situation been for you? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. **Moderately stressful**
4. Mildly stressful
5. Not at all stressful

Q59a. During the past 3 years, have you experienced a change in your family's financial situation (for example, this change may be due to divorce, separation, job loss, money was left to your family, job promotion)? (Circle ONE number)

1. Yes
2. No → **Go to Q60.**

Q59b. How do you feel that this event has affected your financial situation? (Circle ONE number)

1. Things became much better → **Go to Q60.**
2. Things became better → **Go to Q60.**
3. Things stayed pretty much the same → **Go to Q60**.
4. Things became worse
5. Things became much worse

Q59c. How stressful has this situation been for you? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. Moderately stressful
4. Mildly stressful
5. Not at all stressful

Sometimes people feel that they are "disadvantaged", or "deprived" in some way, or that they are missing something that they need compared to other people. People may feel this way for different reasons. For example, a person may feel "deprived" because she feels that she does not have enough money, because her family is troubled in some way, or because she is not doing the things that she expected to do at her age or stage in life.

Q60a. Overall, how "deprived" do you currently feel? (Circle ONE number)

1. Extremely deprived
2. Very deprived
3. Somewhat deprived
4. A little deprived
5. Not at all deprived → **Go to Q61.**

Q60b. What makes you feel most deprived? (Circle all that apply)

1. My family/ my home life
2. My financial situation
3. Other (please specify):_____

_____

Your Family

Questions 61 to 63 ask about your current, immediate family." Immediate family" means different things to different people (e.g., partner, other children, other family members that reside in your home). Please answer these questions for what you consider to be your "immediate family". The following statements describe situations that are commonly found in families.

Q61. The following statements are about how families work together. For *each* of the following statements, please circle the ONE number that best describes your current family.

	Strongly disagree	Disagree	Agree	Strongly agree
Planning family activities is difficult because we misunderstand each other (e.g., because we misunderstand what each other wants, we do not communicate well with each other).	1	2	3	4
In times of crisis, we turn to each other for support.	1	2	3	4
We cannot talk to each other about the sadness we feel.	1	2	3	4
Individuals *are* accepted for who they are.	1	2	3	4
We avoid discussing our fears and concerns.	1	2	3	4
We express feelings to each other.	1	2	3	4
There are lots of bad feelings in our family.	1	2	3	4
We *feel* accepted for who we are.	1	2	3	4
Making decisions is a problem for our family.	1	2	3	4
We are able to make decisions about how to solve problems.	1	2	3	4
We don't get along well together.	1	2	3	4
We confide in each other.	1	2	3	4

Q62. The following statements are about relationships with those in your immediate family. For *each* of the following statements, please circle the ONE number that best describes your family's relationships.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Family members ask each other for help.	1	2	3	4	5
We approve of each other's friends.	1	2	3	4	5
We like to do things with just family.	1	2	3	4	5
Family members feel closer to family than others.	1	2	3	4	5
Family members spend free time together.	1	2	3	4	5
Family members feel very close.	1	2	3	4	5
When family gets together, everyone is present.	1	2	3	4	5
We can easily think of things to do as a family.	1	2	3	4	5
Family members consult other family members on their decisions.	1	2	3	4	5
Family togetherness is important.	1	2	3	4	5

Q63. Overall, how would you describe the amount of stress that you experience because of your immediate family (e.g., family relationships, how your family works together)? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. Moderately stressful
4. Mildly stressful
5. Not at all stressful

Coping with Life's Challenges

These questions ask you about your feelings and thoughts during the LAST MONTH. In each case, please circle the number that indicates how often you felt or thought a certain way.

Q64. In the last month, how often have you been upset because of something that happened *unexpectedly*? (Circle ONE number)

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always

Q65. In the last month, how often have you felt that you were unable to control the important things in your life? (Circle ONE number)

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always

Q66. In the last month, how often have you felt nervous and "stressed"? (Circle ONE number)

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always

Q67. In the last month, how often have you felt confident about your ability to handle your personal problems? (Circle ONE number)

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always

Q68. In the last month, how often have you felt that things were going your way? (Circle ONE number)

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always

Q69. In the last month, how often have you found that you could not cope with all the things that you had to do? (Circle ONE number)

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always

Q70. In the last month, how often have you been able to control irritations in your life? (Circle ONE number)

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always

Q71. In the last month, how often have you felt that you were on top of things? (Circle ONE number)

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always

Q72. In the last month, how often have you been angered because of things that were outside of your control? (Circle ONE number)

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always

Q73. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them? (Circle ONE number)

1. Never
2. Rarely
3. Sometimes
4. Often
5. Always

Q74. Overall, how stressful has the past *month* been for you? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. Moderately stressful
4. Mildly stressful
5. Not at all stressful

Q75. Overall, stressful has the past *year* been for you? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. Moderately stressful
4. Mildly stressful
5. Not at all stressful

Q76. Overall, how stressful have the past *3 years* been for you? (Circle ONE number)

1. Extremely stressful
2. Very stressful
3. Moderately stressful
4. Mildly stressful
5. Not at all stressful

Social Support

In this section are statements that describe how much help you receive at this time in your life. Please circle the number that best describes how true each statement is.

Q77. If I wanted to go on a trip for a day, I would have a hard time finding someone to go with me. (Circle ONE number)

1. Definitely false
2. Probably false
3. Probably true
4. Definitely true

Q78. I feel that there is no one I can share my most private worries and fears with. (Circle ONE number)

1. Definitely false
2. Probably false
3. Probably true
4. Definitely true

Q79. If I were sick, I could easily find someone to help me with my daily chores. (Circle ONE number)

1. Definitely false
2. Probably false
3. Probably true
4. Definitely true

Q80. There is someone I can turn to for advice about handling problems with my family. (Circle ONE number)

1. Definitely false
2. Probably false
3. Probably true
4. Definitely true

Q81. If I decide one afternoon that I would like to go to a movie that evening, I could easily find someone to go with me. (Circle ONE number)

1. Definitely false
2. Probably false
3. Probably true
4. Definitely true

Q82. When I need suggestions on how to deal with a personal problem, I know someone I can turn to. (Circle ONE number)

1. Definitely false
2. Probably false
3. Probably true
4. Definitely true

Q83. I don't often get invited to do things with others. (Circle ONE number)

1. Definitely false
2. Probably false
3. Probably true
4. Definitely true

Q84. If I had to go out of town for a few weeks, it would be difficult to find someone who would look after my house or apartment (the plants, pets, garden, etc.) (Circle ONE number)

1. Definitely false
2. Probably false
3. Probably true
4. Definitely true

Q85. If I wanted to have lunch with someone, I could easily find someone to join me. (Circle ONE number)

1. Definitely false
2. Probably false
3. Probably true
4. Definitely true

Q86. If I was stranded 10 miles from home, there is someone I could call who could come and get me. (Circle ONE number)

1. Definitely false
2. Probably false
3. Probably true
4. Definitely true

Q87. If a family crisis arose, it would be difficult to find someone who could give me good advice about how to handle it. (Circle ONE number)

1. Definitely false
2. Probably false
3. Probably true
4. Definitely true

Q88. If I needed some help in moving to a new house or apartment, I would have a hard time finding someone to help me. (Circle ONE number)

1. Definitely false
2. Probably false
3. Probably true
4. Definitely true

Understanding Who Our Respondents Are

The following questions help us to understand some characteristics about the group of women who participate in this study.

Q89. In what year were you born? (e.g., June, 1980)? (Enter month and year)

_____
(month/ year)

Q90. What is your current marital status? (Circle all that apply)

1. Married
2. Living common-law
3. Widowed
4. Separated
5. Divorced
6. Single, never married

Q91. Which ethnic or cultural group do you identify as *most closely* reflecting your heritage? (Circle ONE number)

1. English Canadian
2. French Canadian
3. Aboriginal Canadian
4. Chinese
5. Jewish
6. South Asian
7. Italian
8. Portuguese
9. Other (specify):_____

Q92a. Were you born in Canada? (Circle ONE number)

1. Yes
2. No

Q92b. What is your country of origin? _____

Q92c. How long have you lived in Canada? _____years

Q93. What was your total household income, before taxes and other deductions during the past 12 months? (Circle ONE number)

1. less than $10,000
2. $10,000 to $19,999
3. $20,000 to $29,999
4. $30,000 to $39,999
5. $40,000 to $49,999
6. $50,000 to $59,999
7. $60,000 to $79,999
8. more than $80,000

Q94a. How many people in total live in your household?
(write number on line) _____

Q94b. How many children (under the age of 18) live in your household?
(write number on line) _____

Q95. What is the highest level of education that you have? (Circle ONE number)

1. elementary school or less
2. some high school
3. completed high school
4. some community college or technical school
5. completed community college or technical school
6. some university
7. completed bachelor's degree
8. graduate degree
9. N/A

Q96. What is the highest level of education that your spouse/partner has?
(Circle ONE number)

1. elementary school or less
2. some high school
3. completed high school
4. some community college or technical school
5. completed community college or technical school
6. some university
7. completed bachelor's degree
8. graduate degree
9. N/A

Thank-you for taking the time to complete this questionnaire!

Appendix F
Implied Correlation Matrix

	Child objective	Child support	Child subjective SEP	Adult support	Adult objective	Adult subjective SEP	Adult family stress	Adult stress past month	Adult financial	Adult deprivation	Child family financial	Child overall stress	Child family stress	SCARED	Stress teen years	Child deprivation	Stress elem years	Adult stress past year	Adult stress past 3 years	PSS
Child objective SEP	1.000																			
Child support	.077	1.000																		
Child subjective SEP	.482	.267	1.000																	
Adult support	.050	.358	.133	1.000																
Adult objective SEP	.345	.027	.166	.017	1.000															
Adult subjective SEP	.189	.128	.424	.178	.509	1.000														
Adult family stress	-.063	-.139	-.096	-.247	-.157	-.260	1.000													
Adult stress past month	-.070	-.155	-.107	-.275	-.174	-.289	.376	1.000												
Adult finance stress	-.081	-.180	-.125	-.320	-.203	-.336	.438	.487	1.000											

	Child objective SEP	Child support	Child subjective SEP	Adult support	Adult objective SEP	Adult subjective SEP	Adult family stress	Adult stress past month	Adult financial stress	Adult deprivation	Child family financial	Child overall stress	Child family stress	SCARED	Stress teen years	Child deprivation	Stress elem years	Adult stress past year	Adult stress past 3 years	PSS
Adult deprivation	-.072	-.160	-.110	-.284	-.180	-.298	.388	.431	.502	1.000										
Child family financial stress	-.162	-.264	-.328	-.138	-.056	-.079	.172	.191	.223	.197	1.000									
Child overall stress	-.206	-.336	-.418	-.175	-.071	-.101	.219	.243	.284	.251	.645	1.000								
Child family stress	-.192	-.313	-.390	-.163	-.066	-.094	.204	.227	.264	.234	.601	.765	1.000							
SCARED	-.120	-.195	-.243	-.102	-.041	-.059	.127	.142	.165	.146	.375	.478	.656	1.000						
Stress teen years	-.169	-.276	-.344	-.144	-.058	-.083	.180	.200	.233	.207	.530	.675	.645	.540	1.000					
Child deprivation	-.160	-.262	-.326	-.137	-.055	-.079	.171	.190	.221	.309	.503	.558	.667	.559	.550	1.000				
Stress elementary years	-.165	-.269	-.336	-.141	-.057	-.081	.176	.195	.228	.202	.518	.659	.656	.550	.541	.559	1.000			
Adult stress past year	-.072	-.160	-.111	-.284	-.180	-.298	.389	.432	.503	.446	-.198	.252	-.255	-.213	-.210	-.217	-.213	1.000		
Adult stress past 3 years	-.061	-.135	-.093	-.240	-.153	-.252	.329	.365	.426	.377	.167	.213	-.215	-.180	-.177	-.184	-.181	.626	1.000	
PSS	-.075	-.166	-.115	-.295	-.187	-.310	.403	.660	.522	.463	.205	.261	-.264	-.221	-.218	-.225	-.222	.464	.392	1.000

Note. Correlations are not reported for individual family cohesion items.
***p < .001. **p < .01. *p < .05.

Appendix G

Potential Mechanisms for Transmission of Stress from Childhood to Adulthood

Initial sensitization to the stress hormone system during early life adversity that produces a biological vulnerability to psychological disorders in adulthood (Nemeroff, 2004; Luecken, Kraft, Appelhans, & Enders, 2009)
Genetic predisposition to stress responsivity (Olff, Langeland, & Gersons, 2005; Steptoe, 2008; Luecken & Lemery, 2004)
Enhanced threat perception as a result of experiencing stress (Chen & Matthews, 2003; Olff et al.)
Ineffective coping mechanisms that lead to increased stress (Olff et al.)
Threat appraisal which directs coping toward "expensive" emotional regulatory process and away from active, problem-solving approaches (Olff et al.)
Personality traits (Olff et al.);
Impaired emotional security, demonstrated as preoccupation with problems, pessimistic view of future, or negative interpretation of new experiences (Davies et al., 2002)
Absence of modulating, protective factors (Olff et al.)
Lack of perceived control over stressors (Chorpita & Barlow, 1998)
Experience of stressful childhood events that may have altered brain structure and/or physiology through plasticity processes (Olff et al.; Luecken & Lemery)

Appendix H

Effects of Family on Psychological Health of Child

Healthy parenting practices that model and promote the development of active coping skills reduce the impact of stress, (Lueckens et al., 2005; Taylor, Lerner, Sage, Lehman, & Seeman, 2004)
Healthy parenting approaches (e.g., consistently responsive, appropriate level of protectiveness) that facilitate opportunities for autonomy can promote a sense of control in the child, which is an important aspect in the perception of stress/anxiety (Chorpita & Barlow, 1998; Cohen et al., 1983)
Parental conflict can create emotional insecurity (e.g., subjective distress, perceived threat) through a sense of fear of family dissolution and worry that the conflict will affect the parent-child relationship (Davies et al., 2002; Davies, Cummings, & Winter, 2004; Lengua, Sandler, West, Wolchik, & Curran, 1999),
Negative parent-child interactions can elevate cortisol levels (Flinn & England, 1997; Luecken, 1998),
Unresponsive, harsh parenting can produce heightened stress reactivity (Gump, Matthews, & Raikkonen, 1999),
High levels of parent-child attachment security promote psychological health (Davies et al., 2002).

Appendix I

Potential Mediators of Low Objective SEP–Stress Relationship

Low objective SEP may act indirectly through intermediary variables related to the process of stress adaptation, given that the availability and effectiveness of psychosocial resources varies by SEP (Taylor & Seeman, 1999).

Potential Mediators
Degree to which an individual has a pervasive, enduring sense of confidence to deal with stress (Richardson & Ratner, 2005)
Inferior problem-solving skills (Young, 1999)
Less perceived control or mastery (Gallo, Bogart, Vranceanu, & Matthews, 2005; Taylor & Seeman)
Greater pessimistic and less optimistic dispositions (Taylor & Seeman; Gallo et al.; Rini, Dunkel-Schetter, Wadhwa, & Sandman, 1999)
Fewer personal resources to cope with stress (Gallo et al.)
Reduced self-esteem (Rini et al., 1999).

In our study, we found that a small part of the stress-reducing effect of adult objective SEP was indirect through adult family cohesion and social support. Previous studies have found that low SEP is associated with poor family functioning (Bradley & Corwyn, 2002; Taylor, Lerner, Sage, Lehman, & Seeman, 2004), low parental warmth (Menard, Bandeen-Roche, & Chilcoat, 2004) and conflict-ridden marital and parent-child relationships (McLoyd, 1998). Low SEP is also related to fewer social

supports (Taylor & Seeman, 1999), and the perception of dominant, controlling relationships and hostile, unfriendly social environments (Gallo, Smith, & Cox, 2006).

Appendix J

Potential Mediators of Social Support–Stress Relationship

Increases sense of mastery (Gadalla, 2009). Note: Gadalla found that social support directly reduced men's perceived stress, but indirectly reduced stress by enhancing women's sense of mastery.
Reduces (a) the extent to which an individual appraises their circumstances as stressful; (b) the impact of stress by providing a solution to problems, reducing the perceived importance of the problem, or providing distraction from the problem; (c) loneliness and negative affect, and provides a sense of belonging and security (Cohen, 1988)
Increases active coping patterns (Giurgescu, Penckofer, Maurer, & Bryant, 2006)
Enhances self-efficacy (Nierop, Wirtz, Bratsikas, Zimmermann, & Ehlert, 2008)

Appendix K

Implied Correlation Matrix for Proposed Model

	Adult deprivation	Child deprivation	Adult stress past year	Adult family stress	Adult stress past month	Adult stress past 3 years	PSS	Adult finance stress	SCARED	Child family stress	Child overall stress	Stress teen years	Stress element yrs	Child finance stress
Adult deprivation	1.000													
Child deprivation	.303***	1.000												
Adult stress past year	.453***	.197***	1.000											
Adult family stress	.365***	.159***	.398***	1.000										
Adult stress past month	.447***	.194***	.486***	.392***	1.000									
Adult stress past 3 years	.390***	.169***	.631***	.342***	.419***	1.000								
PSS	.443***	.192***	.482***	.388***	.667***	.415***	1.000							
Adult financial stress	.501***	.218***	.545***	.439***	.537***	.469***	.532***	1.000						
SCARED	.152**	.343***	.166***	.134**	.163***	.143**	.162***	.183***	1.000					
Child family stress	.237***	.533***	.258***	.208***	.254***	.222***	.252***	.285***	.448***	1.000				
Child overall stress	.260***	.584***	.283***	.228***	.278***	.243***	.276***	.312***	.492***	.764***	1.000			
Stress teen years	.215***	.484***	.234***	.189***	.231***	.202***	.229***	.259***	.408***	.633***	.694***	1.000		
Stress elementary years	.208***	.469***	.227***	.183***	.224***	.195***	.222***	.251***	.395***	.613***	.673***	.626***	1.000	
Child financial stress	.200***	.451***	.218***	.176***	.215***	.188***	.213***	.241***	.379***	.590***	.646***	.536***	.519***	1.000

***p < .001. **p < .01. *p < .05.

Note. Correlations are only reported for the proposed model as they varied little across the models.

Appendix L

Perceived Stress in Childhood Instrument

1. Overall, how would you describe the amount of stress that you experienced as a child (up to age 16) because of your family (e.g., family relationships, how your family worked together)? (Circle ONE number)

6. Not at all stressful
7. Very stressful
8. Moderately stressful
9. Very stressful
10. Extremely stressful

2. How stressful do you feel your life was, compared to that of other children, *when you were in elementary school (i.e., between the ages of 6 and 12)? (Circle ONE number)

6. Essentially stress free
7. Less stressful than most kids
8. About average
9. More stressful than most kids
10. Extremely stressful

3.* How stressful do you feel your life was, compared to that of other children, during your *early teenage years (i.e. age 13 – 16 years). (Circle ONE number)

1. Essentially stress free
2. Less stressful than most kids
3. About average
4. More stressful than most kids
5. Extremely stressful

4. Overall, how stressful was your childhood (up to age 16)? (Circle ONE number)

1. Not at all stressful
2. Very stressful
3. Moderately stressful
4. Very stressful
5. Extremely stressful

***These two items belong to the Global Perceived Early Life Scale (Carpenter et al., 2004)**

Instructions: Sum the scores of each question. Score totals range from 4 to 20 with higher scores representing greater stress.

Appendix M

Perceived Stress in Pregnancy Instrument

Overall, how would you describe the amount of stress that you experience because of your financial circumstances? (Circle ONE number)

6. Extremely stressful
7. Very stressful
8. Moderately stressful
9. Mildly stressful
10. Not at all stressful

Overall, how would you describe the amount of stress that you experience because of your immediate family (e.g., family relationships, how your family works together)? (Circle ONE number)

6. Not at all stressful
7. Mildly stressful
8. Moderately stressful
9. Very stressful
10. Extremely stressful

Overall, how stressful has the past *month* been for you? (Circle ONE number)

6. Not at all stressful
7. Mildly stressful
8. Moderately stressful
9. Very stressful
10. Extremely stressful

Overall, stressful has the past *year* been for you? (Circle ONE number)

6. Not at all stressful
7. Mildly stressful
8. Moderately stressful
9. Very stressful
10. Extremely stressful

Overall, how stressful have the past *3 years* been for you? (Circle ONE number)

1. Not at all stressful
2. Mildly stressful
3. Moderately stressful
4. Very stressful
5. Extremely stressful

Instructions: Sum the scores of each question. Score totals range from 5 to 25 with higher scores representing greater stress.