EXPLORING THE IMPACT OF CHILDHOOD ADVERSITY ON MATERNAL ANXIETY AND SMOKING: THE ALL OUR FAMILIES COMMUNITY COHORT STUDY

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ABSTRACT

The primary focus of this thesis was to investigate the impact of maternal adverse childhood experiences (ACEs) on two pregnancy outcomes: 1) anxiety symptoms and 2) smoking status. The second objective was to determine whether partner support moderated these associations. Secondary statistical analyses were performed using *All Our Families* (*AOF*) study data collected between 2008-2010 in Calgary, Alberta (N = 3,362). Thesis results were non-significant, illustrating that maternal ACEs had no effect on anxiety symptoms and smoking status in pregnancy among a moderate to high socioeconomic status sample. Given that neither of the focal associations under study show statistical significance, partner support as a moderator could not be investigated. It is likely that the moderate to high socioeconomic characteristics of the *AOF* sample were health protective and ameliorated the negative effects of maternal ACEs on anxiety symptoms and smoking in pregnancy.

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LIST OF ABREVIATIONS

AB	Alberta
ACEs	Adverse Childhood Experiences
AOF	*All Our Families*
HPA	Hypothalamic Pituitary Axis
LOWESS	Locally Weighted Scatterplot
NICU	Neonatal Intensive Care Unit
SUID	Sudden Unexpected Infant Death
SSAI	Spielberger's State Anxiety Inventory

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

Maternal mental illness and health-risk behaviours have been linked to neonatal life-threatening conditions (Dietz et al., 2010; Ding et al., 2014; Marufu et al., 2015). For instance, maternal anxiety and smoking increases the likelihood of a low birth weight, pre-term delivery, fetal mortality, and sudden unexpected infant death (SUID) within the first year of life (Biaggi et al., 2016; Ding et al., 2014; Lange et al., 2018; Marufu et al., 2015). Anxiety is one of the most common mental illnesses faced by women during pregnancy, with 23% of women affected (Bayrampour et al., 2018; Falah-Hassani et al., 2017). Women who have anxiety are more likely to smoke as a way to manage their symptoms (Tong et al., 2016). It is estimated that 13% of Canadian women smoke, 10% are daily smokers and 3% occasional smokers (Government of Canada, 2017). Research suggests 50% of mothers who smoke daily pre-pregnancy continue to smoke during their pregnancy (Lange et al., 2018). Anxiety and smoking during pregnancy are prevalent maternal health issues that call for special attention.

Prenatal anxiety symptoms occur when a mother anticipates or believes there is a threat to the pregnancy's outcome (Bayrampour et al., 2016). Anxiety includes feelings of apprehension, worry, tension and nervousness (Spielberger, 2010). Factors that may contribute to maternal anxiety include financial struggles, healthcare related problems, lack of social support, fetal loss, labor, and a lack of resources to support caring for a newborn (Bayrampour et al., 2016). Elevated levels of anxiety can result in increased heart rate, shortness of breath, stomach pain, headaches, dizziness, chest pains, nausea, and fatigue (Bayrampour et al., 2016; Brockington et al., 2006; Kelly et al., 2001). The physiological stress that anxiety places on a mother's body has a direct impact on fetal development and well-being (Dennis et al., 2017;

Shahhosseini et al., 2015). When the mother's body is in a hyperactive state there is a restriction of uterine blood flow and an upsurge of stress hormones, crossing the placenta to the fetus (Van den Bergh et al., 2005). Consequently, maternal anxiety can result in abnormal fetal heart rate, fetal motor inactivity, pre-eclampsia, pre-term delivery, and a low birth weight (Dennis et al., 2017; Ross & McLean, 2006; Shahhosseini et al., 2015). Women who have been abused as a child, previously miscarried, lack social support, belong to an ethnic minority, and smoke are most at risk of experiencing anxiety during their pregnancy (Bayrampour et al., 2018; Tong et al., 2016). Expectant mothers who suffers from anxiety are 1.7 times more likely to smoke (Tong et al., 2016).

Cigarettes contain an addictive chemical, namely nicotine, that enters the body when smoked and provides relieve from feelings of anger and stress (Benowitz, 2010). Nicotine can prevent optimal fetal brain growth, alter gene patterning, cause newborn neurobehavioral problems, and negatively impact newborn affect responses (Froggatt et al., 2020; Roza et al., 2007). Cigarette toxins disrupt fetal blood and oxygen flow by 38%, placing the fetus under immense physical stress (Froggatt et al., 2020). The adverse effects associated with cigarette smoking during pregnancy can be fatal (Froggatt et al., 2020). Approximately one in four SUID cases and 5-7% of pre-term infant deaths are attributed to maternal smoking (Dietz et al., 2010). Miscarriages, stillbirths, low birth weight, and birth malformations (e.g., cryptorchidism, oral clefts, congenital heart defects) are other adverse outcomes associated with maternal smoking (Abraham et al., 2017; George et al., 2006; Lee & Lupo, 2013; Little et al., 2004; Yu et al., 2019; Zhang et al., 2017). Mothers who are uneducated, unemployed, unsupported, young (< 25 years old), live with a smoker, and nicotine dependent (smoke a minimum of 10 cigarettes a day) are more likely to smoke during pregnancy (Boucher & Konkle, 2016; Chung et al., 2010; Cui et al.,

2014; Powers et al., 2013). Previous studies have reported a strong association between childhood adversity and smoking during pregnancy (Blalock et al., 2011; Chung et al., 2010; Harville et al., 2010).

One antecedent risk factor of maternal mental illness and health-risk behaviours is adverse childhood experiences (ACEs) (Bayrampour et al., 2018; Chung et al., 2010; Currie et al., 2020; Currie & Tough, 2021; Racine et al., 2021; Racine et al., 2018; Racine et al., 2020). ACEs are defined as stressful childhood events that are uncontrollable, vary in severity, and occur in familial or other social environments (Kalmakis & Chandler, 2014). ACEs include physical, sexual, and emotional abuse, neglect (e.g., physical, and emotional), and household dysfunction (e.g., substance abuse in the home, divorced/separated parents, mental illness, or imprisonment of a household member) before 18 years of age (Felitti et al., 1998). Approximately one in two people have one or more ACEs (Felitti et al., 1998; Merrick et al., 2018). Multiple studies, including the seminal ACE study, have documented a dose-response association between ACE scores and adult physical health (e.g., diabetes, cancer, heart disease), mental health (e.g., depression, anxiety disorders, suicide), and health-risk behaviours (e.g., substance abuse, sedentary behaviour, high sugar consumption) (Felitti et al., 1998; Hughes et al., 2019; Kalmakis & Chandler, 2015). Links between ACEs, substance use, and mental illness have been well documented in the general population, but there is a paucity of research among perinatal populations (Biaggi et al., 2016; Hughes et al., 2017). A 2018 study among pregnant women documented a dose-response association between maternal ACE scores and anxiety scores (Arbuckle et al., 2018). Pregnant women who have ≥ 3 ACEs are 3.1 and 2.5 times more likely to experience anxiety and consume substances (e.g., smoke, alcohol, or illicit drugs) than

women who did not experience childhood adverse events, respectively (Arbuckle et al., 2018; Chung et al., 2010).

The association between ACEs and unfavourable health outcomes across a lifespan may seem deterministic in nature, however supportive relationships have been identified to serve as a protective factor against negative health effects linked to ACEs (Bellis et al., 2017; Cohen & Wills, 1985). More specifically, scientific evidence suggests that partner support can serve as an effect modifier for both maternal anxiety and smoking linked to ACEs (Cohen et al., 2016; Pilkington et al., 2015; Racine et al., 2019). Partner support could only be tested as a modifier in this thesis, if a significant association between maternal ACEs and anxiety or smoking existed (Szklo & Nieto, 2018). Testing for moderation could identify if there is a difference between supportive and unsupportive partners for symptoms of anxiety and smoking status linked to ACEs, and determine the relative difference (Szklo & Nieto, 2018). In the case of supportive partners, research suggest partner relationships to have a negative (*antagonistic)* effect by lowering maternal anxiety symptomology or smoking status associated with ACEs (Szklo & Nieto, 2018). On the contrary, unsupportive partners could have a positive (*synergistic)* effect on maternal anxiety or smoking, by increasing anxiety symptomology or the likelihood of a positive smoking status (Szklo & Nieto, 2018).

The goal of this thesis was to better understand the impact of ACEs and partner support on pregnancy outcomes, namely anxiety and smoking. Framed by a life course perspective, this thesis contributes to an emerging area of research that is focused on identifying life course factors that can prevent the cascading effect of maternal ACEs into future generations (Ben-Shlomo & Kuh, 2002). The life course perspective sheds light on how childhood adversity and

partner support during pregnancy may either function as a risk or protective factor on maternal anxiety or smoking.

Research questions

In summary, this paper-based thesis examined the following research questions:

Paper 1: Anxiety

1.1 To determine if there is a linear association between maternal ACEs and anxiety at 34-36 weeks' gestation.

1.2 If present, to examine if the association between maternal ACEs and anxiety is moderated by partner support.

Paper 2: Smoking

2.1 To determine if there is an association between maternal ACEs and self-reported smoking at 34-36 weeks' gestation.

2.2 If present, to examine if the association between maternal ACEs and self-reported smoking is moderated by partner support.

1.2 METHODS

Study design

The secondary data analysis for this thesis used data from the *All Our Families (AOF)* study (McDonald et al., 2013; Tough et al., 2017). *AOF* is an on-going community-based longitudinal pregnancy cohort study. The purpose of the *AOF* study is to collect life course information on mother-child dyads and investigate the influence various risk and protective life course factors can have on infants, children and mothers health and well-being (Tough et al., 2017).

Sample

Of 4,011 pregnant women eligible to participate, 83.8% (N=3,362) completed at least one questionnaire. Pregnant women were recruited (May 2008 to December 2010) through maternity clinics (14%), posters and word of mouth (17%), as well as the centralized lab in Calgary (69%) (Tough et al., 2017). To participate, women had to be at least 18 years old, less than 24 weeks pregnant, receiving prenatal care in Calgary, AB, and fluent in English. The *AOF* sample is representative of a pregnant population in a Canadian urban centre (Tough et al., 2017). The proportion of women from the *AOF* study who were 35 years and up, had post-secondary education, and foreign born were similar to nationwide proportions. Compared to nationwide numbers, a larger proportion of women in the *AOF* study had an annual household income above $60,000 (82% compared to 56%) and were married (83% compared to 60%) (Tough et al., 2017).

Data collection

The *AOF* study collected participant information at seven timepoints: before 25 weeks' gestation, 34-36 weeks' gestation, 4 months, 1, 2, 3, and 5 years post birth (Tough et al., 2017). The first, second and sixth data collection timepoints gathered maternal data that were used in this thesis (Tough et al., 2017). The first questionnaire collected socio-demographic data; the second questionnaire gathered data on maternal anxiety, maternal smoking, and partner support, and lastly the sixth questionnaire documented maternal ACE scores (Tough et al., 2017). For each timepoint, participants were asked to complete twenty-five minute mailed out questionnaires (Tough et al., 2017). Participants were asked to return questionnaires by regular mail, if data were missing or clarification of responses were necessary, the research team contacted the appropriate participant (Tough et al., 2017). If a questionnaire was not received

from a participant within three weeks, a reminder to complete the questionnaire was sent by e-mail and/or phone (Tough et al., 2017). The research team made multiple attempts to reach the participant until she was provided with the opportunity to have a repeat mail-out questionnaire or complete the questionnaire over the phone (Tough et al., 2017). To thank participants for completing questionnaires they were given library and grocery store gift cards (Tough et al., 2017). To prevent study attrition, participants were kept engaged and updated through congratulations cards on the birth of their baby and study newsletters were sent out semi-annually (Tough et al., 2017).

There was a decline in the response rate across data collection timepoints. The response rate for the first, second and sixth questionnaire were 99% (N=3,362), 94% (N=3,182), and 69% (N=1,994), respectively (Tough et al., 2017). Factors that contributed to study attrition included delays in funding and ethical approval processes, which resulted in some children surpassing the age range assigned to each follow-up questionnaire (Tough et al., 2017). Other documented reasons for study attrition included participant disinterest, lack of time, unsupportive partners, loss to follow-up, relocation outside of Calgary, and unfavourable study components (e.g., blood collections and linkage to medical records) (McDonald et al., 2013; Tough et al., 2017).

Measures

Outcome: maternal anxiety. Spielberger's State Anxiety Inventory (SSAI) was used to measure anxiety symptoms during pregnancy. SSAI is a 20-item scale (~10 minutes to complete) that measures anxiety caused by specific circumstances and is commonly used in perinatal research to identify elevated levels of anxiety in pregnancy (Meades & Ayers, 2011). Questions are designed to capture *current* feelings of apprehension, tension, nervousness, worry and the activation of the autonomic nervous system; therefore, each question begins with "Right now, (in

this moment)…" (see Appendix 7.2). Participant responses were measured on a 4-point Likert-scale from "Not at all" to "Very much so". Total SSAI scores ranged from 20 to 80. A standard cut-off score of 40 was used to dichotomize women with probable clinical levels of anxiety from those without (Spielberger, 2010). SSAI is a reliable tool that generally yields high internal consistency with Cronbach's α value of 0.91-0.93 (McDonald et al., 2013; Van Knippenberg et al., 1990).

Outcome: maternal smoking. Mothers were asked about their smoking behaviour at 34-36 weeks' gestation: "*Once you knew you were pregnant, how many days per week have you smoked cigarettes (on average)?"* Response options ranged from less than 1 day to 7 days. Women who documented that they have quit smoking during their pregnancy at 34-36 weeks' gestation were coded as 0 = 'non-smokers'. Research among pregnant Canadian women found some under-reporting of maternal smoking status but their results suggest it is still a "fairly accurate" measure with sensitivity and specificity of 85% and 99%, respectively (Arbuckle et al., 2018).

Exposure variable: adverse childhood experiences. ACEs were measured using an adapted version of the original ACE checklist created by Felitti and colleagues (Felitti et al., 1998). Eleven questions were used to capture 8 categories of childhood adversity before the age of 18. The categories consist of emotional, physical, sexual abuse, domestic violence, imprisonment of a household member, divorced/separated parents, caregiver mental illness and/or substance abuse in the home (Felitti et al., 1998). Each category was considered as present or absent with a score of 0 or 1; the sum of all eight categories made up an ACE score (range 0 to 8) (Felitti et al., 1998). ACE data were gathered retrospectively at the sixth questionnaire, see Appendix 7.1 (Bellis et al., 2014; Felitti et al., 1998; Hughes et al., 2017; Racine et al., 2021).

Research shows that asking about ACEs in adulthood yield a low rate of false positives and is a reliable measure to use (Cronbach's $\alpha = 0.88$) (Hardt & Rutter, 2004; Murphy et al., 2014).

Effect modifier: partner support. Various components of partner support were measured using the total score from three self-developed questions. 1.) "How satisfied are you with the social and/or emotional support you receive from your partner?" The four response options ranged from "very satisfied" to "very unsatisfied". 2.) "Does your partner support you in making healthy pregnancy choices?" 3.) "Does your partner provide you with practical support?" Response options for the last two questions ranged from "none of the time" to "all of the time" on a 5-point Likert scale. Responses from the first question was recoded to match the scoring of the other two questions. The scores from each question were totaled (range 3 to 14). Partner support during pregnancy lacks rigor as a construct and measure; researchers elusively define partner support and use disparate indicators to measure it (Pilkington et al., 2015). Researchers have used one question or a combination of questions to measure partner support (Ghosh et al., 2010; Racine et al., 2019; Rini et al., 2006); where others have used validated scales or adapted standardized scales (e.g., *Relationship Questionnaire*, *Social Support Effectiveness Scale*, *Norbeck Social Support Questionnaire* and *Postpartum Partner Support Scale*) (Cheng et al., 2016; Cohen et al., 2016; Pilkington et al., 2015; Stapleton et al., 2012).

Covariates. The following covariates were considered for each research question: maternal age, ethnicity, education, income, and pregnancy intent. Maternal age was calculated from mother's birth date reported. Ethnicity was measured by asking mothers how they would describe their ethnic background. Response options included: White/Caucasian, Black/African North American, First Nations registered, First Nations not registered, Inuit, Metis, Chinese, South Asian, Filipino, Latin American, Southeast Asian, Arab, West Asian, Korean, Japanese,

and mixed/other. Mothers were also asked to report the highest level of education they have completed. Response options included “some elementary or high school”; “graduated high school, some college, trade, university”; “graduated college, trade, university”; “some graduate school”; and “completed graduate school”. Maternal income was measured by asking mothers to report their “*total income, before taxes and deductions, of all household members from all sources in the past 12 months*”. Response options ranged from “less than $10,000” to “more than $100,000”. Pregnancy intent was documented by asking mothers “when you became pregnant were you trying to get pregnant?” with a yes or no response.

Ethics

An application was submitted for ethics approval from the University of Lethbridge Ethics Board, for the purpose of conducting a secondary analysis of the data. Access to the *AOF* study were obtained through an application submitted to Policy Wise. All participants included in the *AOF* study provided written and informed consent to participate and to have their data used for secondary data analysis (Tough et al., 2017). The *AOF* study was approved by the Conjoint Health Research Ethics Board at the University of Calgary (Ethics ID 20821 and 22821) (Tough et al., 2017).

1.3 DATA ANALYSIS STRATEGY

Sample characteristics

To report the characteristics of the sample, mean/standard deviations and frequencies were run for maternal age, ethnicity, education, income, pregnancy intent, mean ACE score, maternal anxiety score (presence and absence of probable clinical anxiety), maternal smoking status (smoker and non-smoker) and partner support (supportive and unsupportive). IBM SPSS

26 was used to run all statistical analyses (IBM Corporation, 2016). The listwise method was used to address any missing data.

Research objective 1.1

In determining whether an association exists between maternal ACE scores and anxiety (SSAI) scores, the linearity of the unadjusted association between ACE scores and anxiety (SSAI) scores were assessed using scatterplots with best-fit regression lines and locally weighted scatterplot smoother (LOWESS) curves. Next, the association between maternal ACE scores and anxiety (SSAI) scores was tested in a linear regression model, unadjusted and covariate adjusted.

Research objective 1.2

Partner support could only be tested as a moderator for the ACEs-anxiety association if the association was statically significant. To determine whether partner support could have moderated the association, I would have started with a LOWESS curve stratified by partner support (supportive vs. unsupportive). If the lines on both curves were the same, it would have been an indication that effect modification was not taking place. If the lines diverged or crossed, it would have been suggestive of an interaction. If the lines diverged a multiplicative term (ACE score x partner support) between ACEs scores and partner support would have been created and included in the linear regression model to test for significance ($p < 0.05$). If the multiplicative term showed significance, a linear regression model stratified by supportive and unsupportive partners would have been needed to assess the significance of heterogeneity between the two groups. Statistical significance in the relative difference would have confirmed a multiplicative interaction taking place.

Research question 2.1

To examine whether the association between maternal ACE scores and smoking status existed, first a new variable splitting ACE scores into terciles was created. This resulted in a final 3-category ACE variable (0 = 0, 1 = 1-3, 2 = ≥ 4). Next, the variable that measured smoking behaviour was recoded into a binary smoking variable (0 = did not smoke in pregnancy, 1 = smoked in pregnancy). After these variables were created, the association between maternal ACE scores and smoking status in pregnancy was tested using a binary logistic regression model, unadjusted and adjusted for covariates. Only women who were at risk for smoking in pregnancy were included in the analysis, subsequently women who did not smoke a cigarette in the 12 months before their pregnancy were excluded.

Research question 2.2

To investigate whether partner support moderates the association between maternal ACE score and smoking status, the association had to be statistically significant. If the main association showed statistical significance, a multiplicative term between each dummy coded maternal ACE score category (0, 1-3, ≥ 4) and partner support would have been created. The multiplicative terms would have been included in the logistic regression model as a way to formally test the difference between logistic coefficients (Jaccard, 2001). Significance of a multiplicative term would have been suggestive of moderation taking place. Next the main regression model would have been stratified by partner support if a multiplicative term showed statistical significance ($p < 0.05$). To illustrate the heterogeneity of effects of the focal association between the two groups of partner support, the main regression model would have been stratified by partner support (Jaccard, 2001).

Covariates

A series of covariates were considered before including in any regression models. These covariates include age, ethnicity, education, income, and pregnancy intent. Each covariate was individually tested in an unadjusted regression model against the outcome variable. Variables that yielded a significance level > 0.20 were retained as a covariate (Bursac et al., 2008). Purposefully, gestational age was not controlled for. Studies on maternal or perinatal health often control for gestational age but in many cases gestational age is an intermediate variable and may introduce bias (Ananth & Schisterman, 2017). Controlling for intermediate variables can produce study findings that underestimate the true impact of ACEs on later-life-health outcomes (Ananth & Schisterman, 2017; Szklo & Nieto, 2018). Caution was exercised to prevent the over adjustment of models (Szklo & Nieto, 2018).

1.4 RESULTS AND SIGNIFICANCE OF RESEARCH

Maternal anxiety and smoking can lead to life-long morbidity and mortality for both mother and fetus (Anderson et al., 2019; Cnattingius, 2004; Littleton et al., 2007; Ross & McLean, 2006; Zhang et al., 2017). Based on previous research, the associations between ACEs, and maternal anxiety and smoking were expected to be significant (Bayrampour et al., 2018; Choi & Sikkema, 2016; Chung et al., 2010; Racine et al., 2021). Contrariwise to what was hypothesized, the findings for this thesis were non-significant for both paper 1 and 2. These findings suggest that there could be other health-protective factors (e.g., socio-economic status) across a life course that can ameliorate the negative effects associated with ACEs. These non-significant findings shed light on the circumstances under which the association between ACEs and pregnancy outcomes (anxiety and smoking) are most likely to be significant. These findings may help inform health professionals on who is most at risk and in need of maternal health programs.

Strengths

During the planning and execution of the *AOF* study multiple stakeholders, such as researchers, healthcare providers, epidemiologists, decision makers and community program experts were consulted for their expertise (Tough et al., 2017). Standardized measures were used; when standardized measures were not available, experts were involved in creating questions to measure a specific construct (Tough et al., 2017). Each variable of interest to the research topic was measured using a reputable, valid and/or standardized tool, except for partner support and smoking status. Even though the study is cross-sectional in nature, ACEs pre-dates maternal health outcomes and behaviours, thus determining temporal sequence.

Limitations

The *AOF* sample is representative of a pregnant population in a large metropolitan city in Canada. Given the sample consists of mothers from a higher income and education level, the generalizability of this thesis' findings are limited to pregnant women of higher socioeconomic status (Tough et al., 2017). There may have been an overrepresentation of anxious mothers given the way questions are phrased in the SSAI (Meades & Ayers, 2011). Self-reported data on unfavourable health behaviours are known to be associated with greater social desirability bias and underreporting; thus, it is assumed that smoking is underreported (Arbuckle et al., 2018). Moreover, mothers with unsupportive partners may be underrepresented, since unsupportive partners were a reason for study attrition. Partner support could have been measured more rigorously by adapting a standardized scale used for social support (Pilkington et al., 2015). Lastly, this thesis used prevalence data; subsequently, additive interactions were not investigated (Szklo & Nieto, 2018).

1.5 THESIS STRUCTURE

Thesis chapters

This paper-based thesis consists of two papers. Each paper explores two different pregnancy outcome variables: anxiety and smoking. ACEs and partner support served as exposure variables for both papers. The content of each chapter is as follow: Chapter 1 is an introduction and overview of the thesis. Chapter 2 provides a narrative review of relevant literature. Chapter 3 discusses the association between mothers with ACEs and anxiety and the impact of partner support. Chapter 4 explains the findings for the association between mothers with ACEs, smoking, and the potential influence of partner support on this association. Since both chapters 3 and 4 includes an introduction, methods, results, and discussion sections, each chapter can be published as two separate papers. Chapter 5 provides an overall discussion of the main findings of this thesis.

CHAPTER 2: REVIEW OF THE LITERATURE

2.1 INTRODUCTION

Decades of research have consistently found the sequelae of childhood adversity (e.g., abuse, neglect, and household dysfunction) to persist into adulthood (Felitti et al., 1998). Researchers have found latent factors that stem from childhood to either re-emerge or manifest physiologically, behaviourally, or psychologically during pregnancy (McDonald et al., 2019; Olsen, 2018; Racine et al., 2018). Psychological challenges and emotional dysregulation may be exacerbated for pregnant women, given pregnancy is a period of significant change (Davis & Narayan, 2020; Gilmore et al., 2018; Li et al., 2020). Psychological challenges and emotional dysregulation may place pregnant women at greater risk for mental illness and continued substance use (Fillo et al., 2019; Li et al., 2020; Scheffers-van Schayck et al., 2019; Strine et al., 2012). Understanding the pathways in which early life adversity impacts mental health and substance use in pregnancy is a growing area of research. Framed by a life course epidemiological perspective, this thesis will explore the impact of ACEs on anxiety and smoking in pregnancy, and the role of partner support as a moderator.

2.2 LIFE COURSE PERSPECTIVE AND CHILDHOOD ADVERSITY

The life course perspective is an interdisciplinary framework that focuses on understanding how early-life experiences can influence health outcomes over a life course and potentially across generations. This framework incorporates the concept of embodied experiences, which explains how biological pathways link childhood adversity to the development of health-risk behaviours and disease later in life (Ben-Shlomo & Kuh, 2002). Periods of significant growth (i.e., childhood, pregnancy) that are key to human development are considered sensitive periods. These periods are considered sensitive due to increased

vulnerability and likelihood of adverse events to impact human development; subsequently the negative effects associated with specific life events can be greater relative to non-sensitive periods (Kuh et al., 2003). Attention is also drawn to the impact of contextual factors (e.g., psychological, sociological, biological, economic, or demographic factors) in shaping health outcomes, future decisions, and experiences. A series of adverse experiences are referred to as chains of risk, which repeatedly put one's health at risk (Ben-Shlomo & Kuh, 2002; Carr et al., 2013; Felitti et al., 1998; Felitti et al., 2019; Halfon & Hochstein, 2002; Rosenman & Rodgers, 2004). Some chains of risk originate from childhood, for example one event of childhood abuse or neglect drastically increases the chances of another taking place (Dube et al., 2001). The life course perspective also recognizes the ability of protective life course factors, such as social support, to interrupt chains of risk and circumvent deleterious effects linked to adversity (Kuh et al., 2003). Research has shown supportive relationships to promote well-being and function as a source of resilience (Bellis et al., 2017; Cohen & Wills, 1985; Sperry & Widom, 2013). Altogether, this framework considers the cumulative and interactive effect of all life course factors, from childhood to adulthood, in shaping health outcomes across a lifespan (Ben-Shlomo & Kuh, 2002).

2.3 ADVERSE CHILDHOOD EXPERIENCES

Defining adverse childhood experiences

ACEs are common and affect individuals across the socioeconomic spectrum. In an large national study (N = 214,157) with data collected from 2011-2014, 61.6% of the sample reported at least 1 ACE and 24.6% reported 3 or more ACEs (Merrick et al., 2018). Research shows individuals from disadvantage backgrounds to be at greater risk of experiencing ACEs (Merrick et al., 2018). Prevalence rates of ACEs are significantly higher among participants who identified

as non-Caucasian, having less than high school education and with an income below $15,000 per annum compared to those who identified as Caucasian, completing high school or more education, and those in higher income brackets (Merrick et al., 2018).

ACEs are described as traumatic experiences before 18 years of age (Felitti et al., 1998). ACEs include three categories of childhood adversity: (1) abuse (sexual, physical, and verbal), (2) neglect (emotional and physical), and (3) household dysfunction (domestic violence, substance misuse, imprisonment, separated/divorced parents, or mental illness of a household member) (Felitti et al., 1998). These events are often uncontrollable, vary in severity, and occur in a child's family or social environment and can cause severe distress that is destructive to the psychological health and development of a child (Kalmakis & Chandler, 2014). Various terms are used interchangeably with ACEs, a term coined by Felitti and collogues in 1998 (Felitti et al., 1998). Other terms commonly used include childhood maltreatment, misfortune, trauma, and abuse. Childhood maltreatment, trauma and misfortune are terms that broadly pertain to all forms of child abuse (e.g., physical, emotional, and sexual), and neglect (physical and psychological) (Kalmakis & Chandler, 2014). To describe childhood adversity, ACEs is a more inclusive term, since it also considers familial and social circumstances (e.g., household dysfunction) that can be harmful to a child's development (Chung et al., 2010; Kalmakis & Chandler, 2014). It is possible for ACEs to be a single traumatic experience, but more often than not it is the chronic exposure to re-occurring adversity (Kalmakis & Chandler, 2014). Studies have found ACEs to be associated with future violence, victimization, health-risk behaviours, chronic illnesses, mental illness, and premature mortality (Felitti et al., 1998; Gilbert et al., 2015; Metzler et al., 2017).

Impact of ACEs on childhood development

Childhood is a sensitive period of human development where the nervous, endocrine and immune systems undergo significant changes (Giedd & Rapoport, 2010). Given secure, supportive, and nurturing environments are essential for proper childhood development, the release of stress hormones triggered by ACEs can be harmful (Kalmakis & Chandler, 2014; Shonkoff & Garner, 2012). When faced with a situation that threatens one's sense of security, the release of stress hormones is innate and an involuntary response. Prolonged periods of distress can result in chronic and elevated levels of stress, which can have lasting harmful effects (Shonkoff & Garner, 2012). Studies have found ACEs linked to altered brain architecture, circuitry patterns and dysregulated physiological processes, such as hyperactivity of the hypothalamic-pituitary-adrenal (HPA) axis (Shonkoff & Garner, 2012). Hyperactivity of the HPA-axis can impair the ability to make decisions, problem solve, store memories, and regulate emotions (De Bellis & Zisk, 2014; Shonkoff & Garner, 2012). Research has linked inflammatory biomarkers and the shortening of telomeres to childhood adversity, both of which are precursors for the development of chronic illnesses (e.g., cancer, cardiovascular disease, and respiratory disease), mental illness, early life mortality (Bellis et al., 2019).

Anxiety linked to ACEs

A body of high-quality evidence linked ACEs to a greater risk of developing mental illness and psychosocial problems later in life (Berens et al., 2017; Edwards et al., 2003; Norman et al., 2012; Shonkoff & Garner, 2012). It is estimated that a third of anxiety disorders in adulthood are attributed by childhood adversity (Green et al., 2010; Kessler et al., 2010). According to a meta-analysis of longitudinal cohort studies individuals with externally documented records of childhood maltreatment were more likely to struggle with depression and

anxiety during adulthood (Li et al., 2016). ACEs can significantly increase a person's risk of developing anxiety by 2-fold (McLaughlin et al., 2010). The uncontrollable nature of adverse childhood events may result in elevated levels of stress, fear, and anxiety over the anticipation of future adversity (Gratz & Roemer, 2004; Marackova et al., 2016). Evidence shows that individuals with childhood adversity have difficulty regulating their emotions, which may be explained by the hyperactivation of the HPA-axis and the inability of the hippocampus to properly function (e.g., control mood) (Gratz & Roemer, 2004; Poole et al., 2017; Shonkoff & Garner, 2012). Given constant worry, fear and avoidance can be debilitating, chronic and high levels of anxiety can significantly compromise a person's quality of life (Löwe et al., 2008; Roy-Byrne et al., 2008; Wittchen et al., 2002). Harmful behaviours, such as smoking and drinking, often serves as a means of coping with negative mood states (Kassel et al., 2003). Women with anxiety are significantly more likely to report pre-pregnancy and prenatal substance misuse (e.g., smoking) relative to mothers with no anxiety (Tong et al., 2016).

Smoking linked to ACEs

According to a systematic review and meta-analysis, illicit drug use was the most prevalent (41%) health-risk behavior attributed to ACEs in North America, followed by harmful alcohol use (27.9%) and smoking (23.7%) (Bellis et al., 2014). There is a strong association between childhood adversity and cigarette smoking (Alcalá et al., 2016; Elliott et al., 2016; Norman et al., 2012). Strong body of evidence shows a graded association between ACEs and early smoking initiation, smoking consumption, and continued smoking across birth cohorts (Acierno et al., 1996; Anda et al., 1999; Dube et al., 2003; Edwards et al., 2007; Nichols & Harlow, 2004). Studies affirm individuals who have experienced childhood adversity to have heightened reactivity responses to stress and are more likely to use maladaptive coping

mechanisms (e.g., substance use) for short-term relief from negative affect (Larkin et al., 2014; Shonkoff & Garner, 2012). Several mediators that could be a part of the causal pathway between ACEs and substance use (e.g., smoking, alcohol use) have been identified by researchers. Potential mediators include psychological distress, education, income, and social support (Douglas et al., 2010; Lin & Chiao, 2021; Strine et al., 2012; Young-Wolff et al., 2019). When smoking a cigarette, nicotine is inhaled releasing neurotransmitters (e.g., dopamine, hypocretins and neuropeptides) that affect the reward centres in the brain (Benowitz, 2010). It's addictive properties (e.g., nicotine and other chemicals) can lead to nicotine dependency (Doubeni et al., 2010). Thus, occasional smokers are at a 10-fold risk of becoming nicotine dependent (Doubeni et al., 2010). Smoking a cigarette can improve concentration, performance of specific tasks, mood and reduce feelings of stress, angst, and anxiety (Benowitz, 2010).

2.4 MATERNAL ANXIETY

Risk factors of maternal anxiety

Nearly a quarter (23%) of pregnant women experience symptoms of anxiety and 15% are diagnosed with an anxiety disorder (Bayrampour et al., 2018). There are multiple life course factors that can contribute to the development of anxiety in pregnancy. Risk factors of anxiety in pregnancy include income, employment, education, social support, and daily stressors (Shahhosseini et al., 2015). Additionally, studies have identified childhood adversity to increase the likelihood of anxiety in pregnancy (Bayrampour et al., 2018; Racine et al., 2021). Psychological and physiological mechanisms have been found to link the pathway between ACEs and anxiety later in life (Poole et al., 2017; Young-Wolff et al., 2019). Young-Wolff (2019) found a dose-response association between maternal ACE scores and anxiety during pregnancy; women who had ≥ 3 ACEs were 3.1 times more likely to experience anxiety (Young-

Wolff et al., 2019). In line with these results, a recent systematic review and meta-analysis reported a dose-response association between ACE scores and anxiety symptoms in pregnancy (Racine et al., 2021). Varying results on the strength of correlation between ACEs and anxiety in pregnancy were found by Racine and colleagues, thus signifying that there may be other moderating variables at play (Racine et al., 2021).

Anxiety in pregnancy

Anxiety is an autonomic body response and is characterized by shallower and faster breathing (Kreibig, 2010). Anxiety includes feelings of apprehension, worry, tension and nervousness (Spielberger, 2010). Largely worry and anxiety during pregnancy are caused by fears surrounding fetal and maternal illnesses, lack of social and financial support and mortality (Bayrampour et al., 2016). Anxiety in pregnancy that occurs intermittently and is short lived is considered normal. In more severe cases, anxiety can interfere with daily life (e.g., responsibilities, relationships, and self-care) (Bayrampour et al., 2016). Anxious mothers may be prone to more nausea, vomiting, pre-eclampsia and/or early labor (Dennis et al., 2017; Ross & McLean, 2006; Young-Wolff et al., 2019). Women who express fear of losing control over the outcome of childbirth are more likely to opt for a caesarean delivery – caesarean deliveries can provide a sense of control and security over the outcome of childbirth (Bayrampour et al., 2016). Anxiety during pregnancy can have powerful long-term effects on both mother and infant (McEwen et al., 2012).

Prenatal risks

Elevated anxiety during pregnancy can result in an increase of stress hormones (e.g., cortisol and catecholamines), which have been identified as a plausible biological mechanism responsible for affecting fetal development and well-being (Giesbrecht et al., 2013). High levels

of anxiety can result in a greater risk of miscarriage, pre-term delivery, and low fetus birth weight (Bayrampour et al., 2018; Ding et al., 2014; Shahhosseini et al., 2015). High maternal anxiety and cortisol levels may lead to decreased blood flow to the fetus, and thus decreased supply of oxygen and nutrients necessary for the development of fetal organs (Young-Wolff et al., 2019). A lack of blood flow and increased cortisol levels can impair the rate of fetal brain growth for mothers who had moderate to severe levels of anxiety during pregnancy (Shahhosseini et al., 2015).

2.5 MATERNAL SMOKING

Risk factors of smoking during pregnancy

Almost 10% of Canadian women are daily smokers, of which half continue to smoke in pregnancy (Government of Canada, 2017; Lange et al., 2018). Higher rates of smoking during pregnancy have been reported among women who are younger than 25, uneducated, unemployed, nicotine dependent (smoke a minimum of 10 cigarettes a day), socially unsupported, and live with a smoker (Boucher & Konkle, 2016; Chamberlain et al., 2017; Chung et al., 2010; Cui et al., 2014; Powers et al., 2013; Public Health Agency of Canada, 2009). Mothers who have experienced childhood adversity are also more likely to continue smoking during their pregnancy (Hughes et al., 2019; Lange et al., 2018). Two studies with large samples found a dose-response association between childhood adversity and greater risk for smoking during pregnancy (Blalock et al., 2011; Chung et al., 2010). A recent study identified education, previous substance use, and depression as mediators explaining the link between ACEs and substance use (including smoking) in pregnancy (Racine et al., 2021). The authors postulated that childhood adversity can lead to socioeconomic hardship and mental health struggles, both of which can increase the risk of substance use in pregnancy (Racine et al., 2021).

Smoking in pregnancy

To cope with stress maternal childhood adversity may increase the risk for maladaptive coping behaviours such as alcohol use, illicit drugs, or smoking in pregnancy (Campbell et al., 2016; Currie et al., 2020; Currie & Tough, 2021; Racine et al., 2020). Mothers who were nicotine dependent pre-pregnancy may find it more difficult to quit or cut down on the number of cigarettes smoked during pregnancy compared to mothers who may have occasionally smoked but were not nicotine dependent (Boucher & Konkle, 2016). In a recent qualitative study pregnant mothers reported that smoking provided a sense of control over their lives and alleviated feelings of stress linked to living with multiple disadvantages, such as substance use, mental illness, poverty, history of violence, abuse, and trauma (Martinez Leal et al., 2021). Despite challenges and barriers mothers may face in trying to quit smoking, pregnancy status has been shown to be a strong motivating factor for mothers to quit for the sake of their baby (Breunis et al., 2019; Xu et al., 2013). Smith et al. (2016) found maternal smoking to be a significant mediating factor between ACEs and poor fetal birth outcomes (Smith et al., 2016).

Prenatal risks

It is well known that smoking is a health-risk behaviour that is harmful to both the mother and fetus. Nicotine, tar, and carbon monoxide from a cigarette directly effects the fetus by crossing the placenta and impeding blood-oxygen flow, subsequently placing the fetus under stress. This can result in gene patterning modifications, reduced brain growth and fetal death (Froggatt et al., 2020; McDonnell & Regan, 2019; Roza et al., 2007). The morbidity and mortality related to nicotine exposure during pregnancy is substantial, with 38% and 31% of still births and infant deaths attributed to tobacco use, respectively (Boucher & Konkle, 2016). A 2015 meta-analysis ascertained that there is a graded association between maternal smoking and

risk of still birth (Marufu et al., 2015). Other adverse fetal health outcomes linked to nicotine consumption during pregnancy include miscarriage, pre-term delivery, developmental disruptions, and SUID (Anderson et al., 2019; Boucher & Konkle, 2016; Marufu et al., 2015). The risk of SUID increases 2.4 (CI 2.31-2.57) times when a pregnant mother decides to smoke (Anderson et al., 2019). The likelihood of SUID consistently increases with each cigarette smoked daily but reaches a plateau at 20 or more cigarettes (Anderson et al., 2019). The likelihood of adverse health outcomes correlated with smoking during pregnancy decreases when mothers smoke less or quit smoking entirely (Abraham et al., 2017; Anderson et al., 2019). For infants, long-term adverse effects linked to maternal smoking include respiratory illness, neurodevelopmental and behavioural problems (Public Health Agency of Canada, 2009). Whether mothers continue to smoke during pregnancy or not is strongly influenced by one of their closest relationships (Tsvetkova et al., 2018).

2.5 MATERNAL PARTNER SUPPORT

Defining partner support during pregnancy

Supportive relationships have been shown to mitigate adverse health outcomes and promote emotional and mental well-being (Bellis et al., 2017; Cohen et al., 2016). The level of support provided by a partner may be different from that of family and friends, since a partner relationship typically involves increased physical and emotional closeness that is not found in other relationships (Morse et al., 2000; Ross et al., 2017). Emotional closeness described as a sense of belonging, affections and commitment to the relationship (Pilkington et al., 2015). In a longitudinal study comparing the degree of support received from a partner, family member and friend, the greatest level of support during pregnancy came from a partner (Morse et al., 2000). Thus, partner relationships can be highly influential (Morse et al., 2000). The ideal partner

during pregnancy has been described as present, available, understanding, and prepared to provide emotional, physical, and financial support. Mothers have also accentuated "togetherness" during pregnancy as an important aspect of feeling supported. "Togetherness" has been described to provide mothers with a sense of security and shared responsibility in having a child together (Alio et al., 2013). Studies show relationship dynamics to influence maternal biological and psychological processes, thus having the potential to impact maternal mental well-being and health behaviours (Flemming et al., 2015; Rini et al., 2006; Stapleton et al., 2012; Thompson et al., 2011; Yim et al., 2015). Research has found women in supportive relationships more likely to have higher levels of psychological well-being, practice health promoting behaviours, and experience healthier pregnancies relative to women in unsupportive relationships (Appleton et al., 2019; Ghosh et al., 2010; Lobel et al., 2008; Racine et al., 2019; Rini et al., 2006)

Impact of partner support on negative effects linked to ACEs

Research shows feeling socially supported across the life course to buffer the harmful effects of ACEs on mental health and health behaviours (Cohen & Wills, 1985; Sperry & Widom, 2013). Support can improve psychological dispositions and stress appraisals during pregnancy, a time of drastic change and substantial challenges for some (Cohen & Wills, 1985; Thoits, 2011). Two longitudinal studies, one by Racine et al. (2018) and the other by Appleton et al. (2019), have found social support to protect against the adverse effects of maternal ACEs on antepartum risk and infant birth outcomes, respectively (Appleton et al., 2019; Racine et al., 2018). Research suggests that supportive partner relationships can be impactful in protecting against mental illness and substance use in pregnancy, but more research is needed to determine

whether the adverse effects associated with childhood adversity can be moderated (Appleton et al., 2019; Cohen et al., 2016; Jaffee et al., 2017; Pilkington et al., 2015).

Partner support and maternal anxiety

Supportive partners have the potential to lessen the burden of stress on mothers, which in turn protects against symptoms of anxiety (Ghosh et al., 2010; Rini et al., 2006). Given mothers with a history of ACEs are more likely to suffer from emotional and HPA-axis dysregulation, supportive relationships can help women regulate their emotions when faced with adversity, drastic change or unexpected events (Cicchetti, 2013). In particular, a longitudinal study found mothers with high levels support from a partner to report fewer anxiety symptoms in pregnancy, compared to women in partner relationship with little to no support (Rini et al., 2006). Partner support can protect against anxiety symptoms; however, unsatisfactory support may contribute to maternal stress levels, and subsequently increase anxiety levels (Bayrampour et al., 2018; Figueiredo et al., 2008; Nasreen et al., 2011) Bayrampour et al. (2016) found low social support and a history of abuse were associated with chronic levels of anxiety during pregnancy. The impact of partner support on anxiety during pregnancy is understudied comparative to depression (Pilkington et al., 2015). In cases where pregnant women are not supported by their partners, they may turn to unhealthy coping mechanism, including health-risk behaviours such as smoking (Tong et al., 2016). Pregnant women struggling with anxiety symptoms are more likely to smoke as a way to cope (Tong et al., 2016).

The influence of partner support and maternal smoking behavior

The literature suggests supportive partners may be the most influential factor in smoking cessation for pregnant women (Boucher & Konkle, 2016). Cohen et al. (2016) found that 2.6% of women with partners smoked during pregnancy compared to 12.2% without partners.

Similarly, women with involved partners were more likely to receive early prenatal care and were able to reduce their cigarette consumption by 36% relative to mothers without involved partners (Martin et al., 2007). Fergie et al. (2019) found a supportive partner to increase an expectant mother's likelihood of smoking cessation, and unsupportive partners to be a difficult barrier to overcome. Unsupportive partners may leave cigarettes easily accessible and continue to smoke in the home, compared to supportive partners who may help establish a smoke-free home and encourage mothers to find an alternative to smoking (Fergie et al., 2019). Partners who decide to also quit smoking is perceived as supportive by mothers and may provide a level of companionship that can be instrumental for a mother's success in smoking cessation (Gage et al., 2007; McBride et al., 2004). Pregnant women who had partners who also quit smoking were six times more likely to be successful in smoking cessation, in comparison to mothers with partners who continued to smoke (Gage et al., 2007).

2.6 CONCLUSION

A mounting body of evidence has established that ACEs place a woman's health and well-being at risk across a lifespan (Felitti et al., 1998; Hughes et al., 2019; Kalmakis & Chandler, 2014). Women who have been exposed to ACEs are more likely to suffer from anxiety and smoking (Felitti et al., 1998; Hughes et al., 2019; Kalmakis & Chandler, 2014). Research suggests this association to also exists among perinatal populations (Appleton et al., 2019; Blalock et al., 2011; Chung et al., 2010; McDonald et al., 2019; Racine et al., 2019). Studies have identified social support as a protective life course factor and suggests that partner support may act as a buffer against anxiety and smoking among pregnant mothers with a history of ACEs (Appleton et al., 2019; Racine et al., 2018). To my knowledge, the impact of ACEs and partner relationships on anxiety or smoking during pregnancy is yet to be examined in a single study.

This thesis builds on existing knowledge of the impact of ACEs on pregnancy outcomes in a sample of women recruited from a city in Alberta, Canada. Identifying social factors that can prevent the cascading effects of maternal ACEs is warranted and may serve to identify areas for intervention.

CHAPTER 3: EXPLORING THE IMPACT OF CHILDHOOD ADVERSITY ON MATERNAL ANXIETY

3.1 INTRODUCTION

Maternal anxiety is a widespread problem with one in four (23%) pregnant women affected; this is of particular concern because it puts the health of both mother and fetus at risk (Bayrampour et al., 2018). Anxiety can be harmful as it results in an increase of stress hormones in pregnant women, which can indirectly impact the developing fetus (Van den Bergh et al., 2005). Elevated levels of maternal stress hormones can reduce the blood flow to the fetus – restricting oxygen and nutrients supply required for proper fetal growth and development (Shahhosseini et al., 2015; Van den Bergh et al., 2005). Adverse outcomes associated with anxiety during pregnancy are abnormal fetal heart rate, motor inactivity, growth restrictions, low birth weight, pre-eclampsia, and pre-term delivery (Dennis et al., 2017; Lewis et al., 2016; Ross et al., 2020; Shahhosseini et al., 2015; Skouteris et al., 2009). For these reasons, it is highly pertinent to study anxiety among pregnant women.

Anxiety is described as an autonomic response of emotions to a stressor and includes feelings of apprehension, worry, tension and nervousness (Spielberger, 2010). Physiological responses to anxiety include increased heart rate, shortness of breath, stomach pain, headaches, dizziness, chest pains, nausea, and fatigue (Andersson et al., 2012; Brockington et al., 2006; Kelly et al., 2001). Women who suffer from anxiety may also feel emotionally detached, insecure, irritable, short tempered, suicidal, panicked and fear the unknown associated with the trajectory their pregnancy may take (Bayrampour et al., 2016; Bayrampour et al., 2015). Women who express fear of the unknowns related to pregnancy and childbirth are more likely to opt for a

caesarean delivery to feel a sense of control over the outcome of childbirth (Bayrampour et al., 2016; Dennis et al., 2017).

Feelings of anxiety tend to be temporary and may fluctuate in intensity over the course of pregnancy (Spielberger, 2010). While occasional and short-lived anxiety is considered normal and manageable, chronic anxiety may require intervention as it can interfere with everyday life including relationships, responsibilities, self-care, and problems sleeping (Bayrampour et al., 2016). Life course factors that may trigger or worsen chronic anxiety for pregnant women include financial difficulties, inadequate access to health care, and a lack of social and partner support (Bayrampour et al., 2016). Pre-pregnancy factors that may predispose women to experience anxiety during pregnancy include a history of mental illness, unsuccessful pregnancies, and childhood abuse (Bayrampour et al., 2018).

ACEs may confer a risk of developing prenatal anxiety (Bayrampour et al., 2018; Choi & Sikkema, 2016; Racine et al., 2021). ACEs are described as traumatic experiences that happen before 18 years of age and include events of abuse, neglect, and household dysfunction (Felitti et al., 1998). A child may experience elevated levels of stress depending on the severity and intensity of these events. When these traumatic events are recurring or prolonged, they can have damaging effects on a child's developing biological body systems (e.g., nervous, endocrine, and immune systems) (Danese et al., 2009). ACEs have been associated with altered brain structure, circuitry patterns and dysregulated physiological processes, thus increasing the vulnerability of mental illness and chronic diseases across a lifespan (Shonkoff & Garner, 2012).

As a by-product of ACEs, emotional dysregulation is characterized by difficulties in recognizing and processing emotions, and responding to emotional experiences (Gratz & Roemer, 2004). Family contexts that are unpredictable, abusive and neglectful are less equipped

to provide safe and secure environments, which are essential components for emotional regulation to be reached (Mennin et al., 2002). A model by Hofmann and colleagues suggests that emotional dysregulation lies at the core of mood and anxiety disorders (Hofmann et al., 2012). Despite this, not everyone who have had early life adversities develop anxiety disorders during adulthood (Appleton et al., 2019; Racine et al., 2020).

Supportive social networks have shown great beneficial effects on physical and psychosocial well-being (Ghosh et al., 2010; Lobel et al., 2008; Racine et al., 2019; Rini et al., 2006). Scientific evidence has identified supportive relationships to be a protective factor against poor health outcomes linked to ACEs (Appleton et al., 2019; Racine et al., 2020). Relative to support received from social networks, there is less known about the role partner support plays on the association between ACEs and poor health outcomes (Appleton et al., 2019; Bellis et al., 2017; Cohen & Wills, 1985; Jaffee et al., 2017). The level and type of support found in partner relationships may be different from that of family and friends (Morse et al., 2000; Ross et al., 2020). In a longitudinal study the greatest level of support during pregnancy came from a partner when compared to other relationships (Morse et al., 2000). This demonstrates that partner relationships can be instrumental in providing maternal support during pregnancy. Supportive relationships provide women with emotional connection, stability, and practical support, all of which have shown to improve emotional regulation following ACEs (Butler & Randall, 2012; Pilkington et al., 2015). Physiologically, supportive relationships enhance the ability to adapt to stressors and increase psychosocial resilience, which has proven to act as a buffer against anxiety associated with ACEs (Poole et al., 2017). There is a need for more research to better understand the association between ACEs and maternal anxiety, specifically regarding the modifying role social factors may play.

Building on previous knowledge, the aim of this study was to investigate the impact of ACEs and partner support on anxiety during pregnancy. Since both childhood and pregnancy are considered sensitive developmental periods, it is postulated that the effects of ACEs and partner support during pregnancy may be impactful (Ben-Shlomo & Kuh, 2002). The research objectives under study are posed using a life course approach, particularly the effect of social factors during sensitive developmental periods on maternal anxiety (Ben-Shlomo & Kuh, 2002).

Study objectives

1. To determine if there is a linear association between maternal ACEs and maternal anxiety at 34-36 weeks' gestation.
2. If present, to examine if the association between maternal ACEs and maternal anxiety is moderated by partner support.

3.2 METHODS

Sample and data collection

This secondary analysis used data from the *All Our Families (AOF)* study, which is an ongoing community-based longitudinal pregnancy cohort study (McDonald et al., 2013; Tough et al., 2017). The aim of *AOF* is to collect life course information on mother-child dyads and investigate the influence that various life factors may have on infant and maternal health (Tough et al., 2017). To become a participant, women had to be at least 18 years of age, less than 25 weeks pregnant, receiving prenatal care in Calgary, Alberta, and be fluent in English. A total of 3,387 women were recruited from May 2008 to December 2010 through maternity clinics, posters, word of mouth, and a centralized lab service available to all pregnant women in Calgary, Alberta (Tough et al., 2017). For this secondary analysis women who identified as single were excluded given a key goal of the analysis was to examine partner support.

Data for *AOF* were collected at seven timepoints: before 25 weeks' gestation, 34-36 weeks' gestation, and at 4 months, 1, 2, 3, and 5 years post birth (Tough et al., 2017). Maternal data used in the present secondary analysis were collected at the first, second and sixth data collection timepoints (before 25 weeks, 34-36 weeks, 3 years). The first timepoint collected socio-demographic information; the second gathered data on maternal anxiety and partner support; and the sixth timepoint collected information on maternal ACE scores. Questionnaires at each timepoint were mailed out and took approximately 25-minutes to complete (Tough et al., 2017). Participants could complete the questionnaires by mail or phone. Participants were provided with honorariums (e.g., library and grocery gift cards) to thank them for their time. Additional efforts made to prevent study attrition included following-up with participants to complete questionnaires, sending out newborn congratulations cards and semi-annual *AOF* study newsletters (Tough et al., 2017).

Despite retention efforts, there was a decline in the response rates across data collection timepoints. The response rate for the first, second and sixth questionnaire was 99% (N = 3,362), 94% (N = 3,182), and 69% (N = 1,994), respectively (Tough et al., 2017). Factors that contributed to study attrition were delays in ethical approval, loss of participant interest, shortage of time, unsupportive partners, loss to follow-up, change of residence outside of Calgary, unfavorable study components (e.g., blood collections and linkage to medical records) and unknown reasons. For the present analysis only women who returned their questionnaire for the sixth data collection timepoint and completed all relevant questions related to anxiety during pregnancy, ACEs, partner support and socio-demographic variables were included (*N = 1,480*).

Measures

Outcome: maternal anxiety. Maternal anxiety was measured using the 20-item scale called the Spielberger's State Anxiety Inventory (SSAI). State anxiety is defined as a temporary emotional response caused by a particular stressor. The emotional response may fluctuate over time and vary in intensity (Spielberger et al., 1982). The 20 items measure current feelings of apprehension, tension, nervousness, and worry on a 4-point intensity scale from "Not at all" to "Very much so" (see Appendix 7.2). Ten items (1, 2, 4, 8, 10, 11, 15, 16, 19 and 20) were negatively keyed and reverse scored before the total score with all 20-items were summated. The sum of anxiety scores ranges from 20 to 80 with higher scores indicating higher levels of anxiety. A conventional cut-off score of 40 was used to separate women with probable clinical levels of anxiety from those without (Spielberger et al., 1982). SSAI is a validated tool in perinatal research that is able to identify anxiety symptomology during pregnancy (Meades & Ayers, 2011). SSAI is a reliable tool that yields high internal consistency, with Cronbach's α value of 0.84 in perinatal populations (Gurung et al., 2005). The Cronbach's alpha is 0.87 for the present study.

Exposure: adverse childhood experiences. An adapted version of the original ACE checklist created by Felitti and colleagues was used to measure ACE scores (1998). Eleven questions were asked to capture the exposure of eight categories of ACEs before 18 years of age: emotional abuse (1 question), physical abuse (1 question), sexual abuse (3 questions), domestic violence (1 question), imprisonment of a household member (1 question), separated parents (1 question), caregiver mental illness (1 question) and/or substance abuse in the home (2 questions) (Felitti et al., 1998). Each category is either considered as present or absent with a score of 0 or 1; the sum of all eight categories made up an ACE score (range 0 to 8) (Felitti et al., 1998).

Consistent with other studies, the sample was categorized as having 0, 1, 2, 3, or 4 or more ACEs (Anda et al., 2006; Dube et al., 2003; Felitti et al., 1998; Racine et al., 2018). These data were collected at the sixth data collection timepoint and are retrospective in nature. Evidence shows that ACE scores reported in adulthood have a low rate of false positives and the retrospective collection of ACE data has shown satisfactory test-retest reliability (Cammack et al., 2016; Hardt & Rutter, 2004; Murphy et al., 2014). This scale is a reliable measure (Cronbach's $\alpha = 0.88$) (Hardt & Rutter, 2004; Murphy et al., 2014). This adapted ACE checklist showed adequate internal consistency in the present study ($\alpha = 0.71$) (Vaske et al., 2017).

Effect modifier: partner support. Partner support was measured using three questions that were developed by the researchers of the *AOF* study: 1) "How satisfied are you with the social and/or emotional support you receive from your partner?", for which responses were measured on a 4-point Likert scale ("very satisfied" to "very unsatisfied") and reverse scored; 2) "Does your partner support you in making healthy pregnancy choices?" and; 3) "Does your partner provide you with practical support?". Response options for the last two questions ranged from "none of the time" to "all of the time" on a 5-point Likert scale. The scores from each question were summed to give a partner support score (range = 3 to 14) with higher scores indicating higher partner support. Partner support scores of 10 or lower were classified as unsupportive partners and scores of 11 or above were classified as supportive partners. This measure is on the verge of being considered adequate with a Cronbach's alpha of 0.63 (Vaske et al., 2017).

Covariates. Maternal income, education, ethnicity, and age were examined as covariates in this analysis (Table 1). Maternal income was measured by asking mothers what their "total income, before taxes and deductions, of all household members from all sources in the past 12

months". Options ranged in $10,000 increments starting at "less than $10,000" to "more than $100,000". Mothers were also asked what the highest level of education they have completed, response options included: some elementary or high school; graduated high school, some college, trade, university; graduated college, trade, university; some graduate school; completed graduate school. Ethnicity was measured by asking mothers how they would describe their ethnic background. Response options were: White/Caucasian, Black/African North American, First Nations registered, First Nations not registered, Inuit, Metis, Chinese, South Asian, Filipino, Latin American, Southeast Asian, Arab, West Asian, Korean, Japanese, and mixed/other. Mothers were asked to report their birth date, which was used to calculate maternal age.

Ethics

The *AOF* study was approved by the Conjoint Health Research Ethics Board at the University of Calgary (Ethics ID 20821 and 22821). Ethical approval was given by the University of Lethbridge Ethics Board for conducting this secondary data analysis (Ethics ID 2020-083). Access to the *AOF* study was obtained through an application submitted to PolicyWise for Children and Families.

3.3 STATISTICAL ANALYSIS

Sample characteristics

Descriptive analyses were used to examine sample characteristics. Demographic information was examined by modes, means, and standard deviations. Trends in the data were assessed via cross-tabulations. An assessment of skewness revealed that there was some positive skewness. Given the large sample size, skewness was within acceptable limits with z-scores falling between negative 4.0 to positive 4.0.

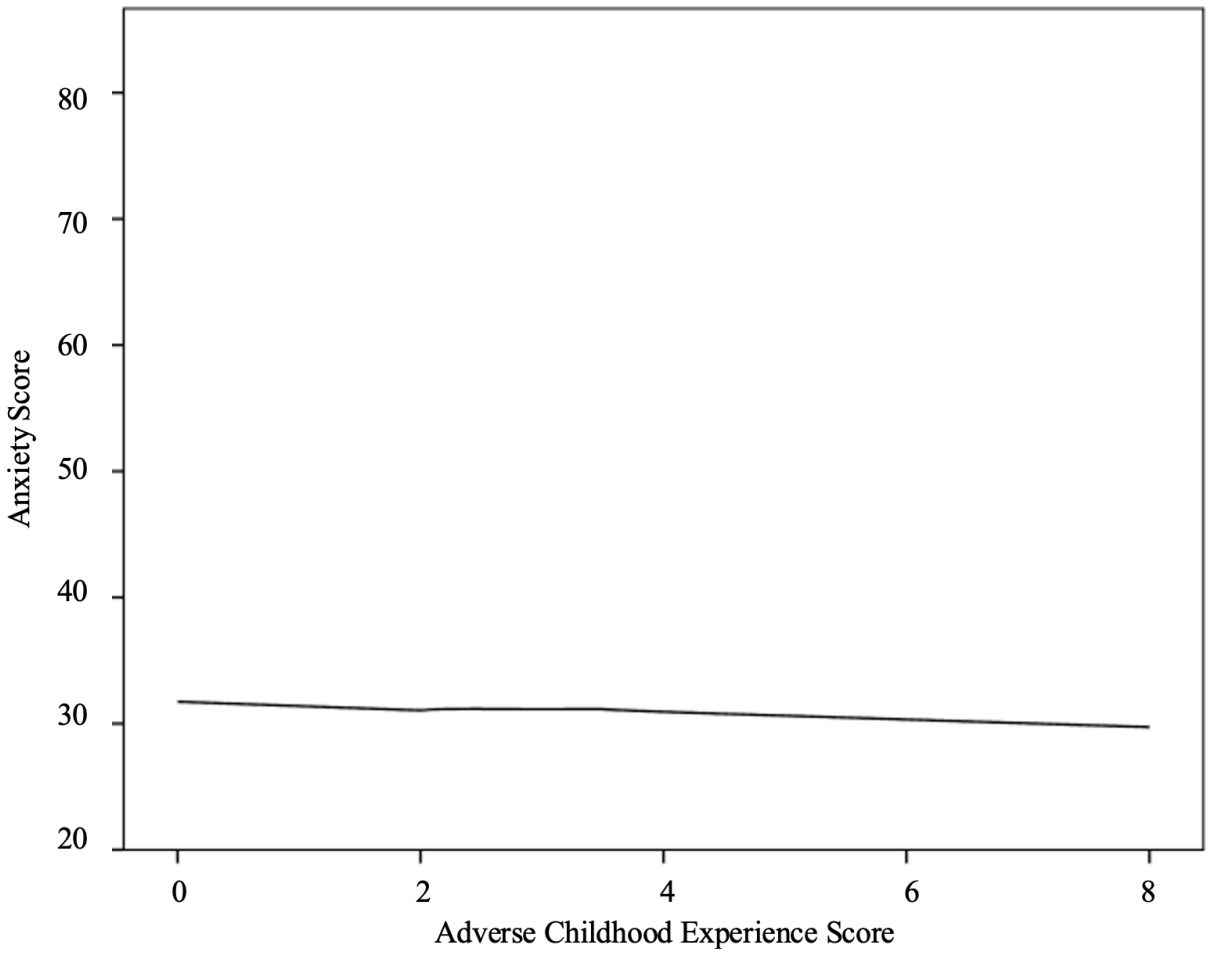

Figure 1: LOWESS Curve Illustrating the Association Between Maternal ACE Score and SSAI Score

Analysis strategy: research objective 1

Participants responded to 11 questions that measured 8 categories of childhood adversity, each of which were coded as present or absent. Response options for questions 1 through 5 were yes = 1 and no = 2, which were recoded as present = 1 and absent = 0, respectively. Responses from questions 6 through 11 had 3 response options (1 = never, 2 = once, 3 = more than once) and were recoded as 1 = present (once or more) and 0 = absent (never). This followed the same coding pattern used for questions 1 through 5. Multiple questions were used to document two ACE categories: sexual abuse and substance abuse in the home. Scoring for both categories were

individually summed and a score ≥ 1 was coded as present = 1 and a score of 0 was coded as absent = 0. To create a final ACE score, values from all 8 categories (e.g., emotional, physical and/or emotional abuse, domestic violence, imprisonment of household member, separated parents, caregiver mental illness and/or substance abuse in the home) were summed creating a totaled ACE score ranging from 0 to 8. Anxiety scores (SSAI) were computed using 20 questions that had response options measured on a 4-point intensity scale (1 = "Not at all" to 4 = "Very much so"). Ten questions (1, 2, 4, 8, 11, 15, 16, 19, and 20) were reverse scored to ensure all questions followed the same scoring pattern. Next, the score of all questions were totaled creating an anxiety score ranging from 20 to 80 (Spielberger et al., 1982).

To assess for a linear association between ACE scores and anxiety scores, a scatterplot with best fit-regression lines and locally weighed scatterplot smoother (LOWESS) curves were used. The scatterplot with a LOWESS curve (Figure 1) suggested that there was no correlation between maternal ACE scores and anxiety scores (SSAI). Next, two linear regression models with 95% confidence intervals (CIs) were used to assess if there was a statistically significant change in anxiety score per unit difference in the ACE score, unadjusted and adjusted for covariates. Covariates entered in the final regression model were income, education, age, and ethnicity. Most studies on maternal ACEs and mental health during pregnancy adjusted for these socio-demographic variables (Letourneau et al., 2019; Racine et al., 2018; Racine et al., 2020; Shin et al., 2021; Young-Wolff et al., 2019). Controlling for similar variables in the model allows for study estimates to be comparable to other studies. Studies on maternal or perinatal health often control for gestational age but in many cases gestational age acts as an intermediate variable (Ananth & Schisterman, 2017). Controlling for variables that lie on the casual pathway would result in biased estimates (VanderWeele, 2019). Thus, gestational age was not controlled

for in the model. All analyses were run using SPSS 26. Listwise deletion was used to address any missing data.

Analysis strategy: research objective 2

The association between ACEs and anxiety needed to show statistical significance to test partner support as a moderator of the association. If the focal association was statistically significant, I would have created a LOWESS curve stratified by partner support (supportive vs. unsupportive). The direction of the lines on the LOWESS curves would have been analysed to see if the lines on both curves were the same or diverged. If the lines were the same that would have suggested that effect modification was not taking place. If the lines on both curves diverged or crossed it would have indicated that an interaction was taking place. If the latter was the case, a multiplicative term (ACEs score x partner support) between ACEs scores and partner support would have been entered into the regression model and tested for significance ($p < 0.05$). If the multiplicative term showed significance, a linear regression model stratified by supportive and unsupportive partners would have been needed to assess the significance of heterogeneity between the two groups. Statistical significance in the relative difference would have proven a multiplicative interaction was in fact taking place (Szklo & Nieto, 2018).

Table 3.1

Total Sample Characteristics Stratified by Anxiety Score Cut-off

Sample Characteristics	Full Sample *N (%)*	SSAI Score < 40 *n* (%)	SSAI Score ≥ 40 *n* (%)
Total	1,480 (100)	1,165 (78.7)	315 (21.3)
Age			
< 35 years	1,222 (82.6)	965 (82.8)	257 (81.6)
≥ 35 years	258 (17.4)	200 (17.2)	58 (18.4)
Ethnicity			
Caucasian	1,165 (78.7)	929 (79.7)	236 (74.9)
Non-Caucasian	258 (21.3)	236 (20.3)	79 (25.1)
Highest Level of Education Completed			
Elementary/high school	159 (10.7)	107 (9.2)	52 (16.5)
Some college/trade/undergraduate school	1,081 (73.0)	857 (73.6)	224 (71.1)
Some graduate school	240 (16.3)	201 (17.3)	39 (12.4)
Income			
< $10,000-$39,999	120 (8.1)	73 (6.3)	47 (14.9)
$40,000-$69,999	220 (14.9)	153 (13.1)	67 (21.3)
$70,000-$99,999	378 (25.5)	298 (25.6)	80 (25.4)
≥ $100,000	762 (51.5)	641 (55.0)	121 (38.4)
Partner Support			
Supportive partner	1,387 (93.7)	1,125 (96.6)	262 (83.2)
Unsupportive partner	93 (6.3)	40 (3.4)	53 (16.8)
Maternal ACE Mean Score (SD)	1.6 (SD = 1.8)	1.7 (SD = 1.8)	1.4 (SD = 1.7)
Maternal ACEs			
0	557 (37.6)	423 (36.3)	134 (42.5)
1	324 (21.9)	248 (21.3)	76 (24.1)
2	206 (13.9)	171 (14.7)	35 (11.1)
3	165 (11.1)	135 (11.6)	30 (9.5)
≥ 4	228 (15.4)	188 (16.1)	40 (12.7)

3.4 RESULTS

Sample characteristics

Sample characteristics are shown in Table 1. The women ranged in age from 18-46 years (*M* = 30.4 years, *SD* = 4.4) and most identified as Caucasian (78.7%). The proportion of women who identified as non-Caucasian in this sample are similar to that of Canadian national averages (21.3% vs 19.1%) (Statistics Canada, 2011b). The women were highly educated as 73.0% had at least some college, trade, or undergraduate education and 16.3% had at least some graduate education. Overall, half (51.5%) of the women lived in a household with an income of $100,000 or more, a quarter (25.5%) reported having a household income between $70,000 and $99,999 and the rest (22.9%) reported having a household income below $70,000. Approximately half (51.5%) of the sample had household incomes above the median ($95,895) for households with children when compared to Canadian national averages (Statistics Canada, 2011a). All women were partnered (e.g., identified as currently having a romantic partner); 93.7% of the women reported having supportive partners.

Maternal ACE scores

In the current sample, the mean maternal ACE score was 1.6 (*SD* = 1.8, range = 0 to 8) on a scale of 0 to 8. Consistent with other ACE studies, most of the women (62.3%) reported having at least one ACE, with 25% having 2-3 ACEs and 15.4% with 4 or more (17,46). The mean anxiety score in the sample was 32.4 (*SD* = 9.1) (range = 20 to 80); 2 in 10 (21.3%) women experienced probable clinical levels of anxiety at 34-36 weeks' gestation.

Table 3.2

Means and Standard Deviations for Anxiety Across Socio-Demographic Variables and Partner Support (N = 1,480)

	n	*M (SD)*
Age		
< 35	1,222	32.41 (9.14)
≥ 35	258	32.31 (9.19)
Ethnicity		
Caucasian	1,165	32.17 (9.04)
Non-Caucasian	258	33.24 (9.49)
Education		
≤ Elementary/high school	159	34.74 (10.14)
≥ Some college/trade/undergraduate school	1,081	32.23 (8.90)
≥ Some graduate school	240	31.60 (9.33)
Income		
< $10,000-$39,999	120	37.15 (10.58)
$40,000-$69,999	220	34.35 (10.68)
$70,000-$99,999	378	32.42 (8.48)
≥ $100,000	762	31.07 (8.36)
Partner Support		
Supportive	1,387	31.79 (8.73)
Unsupportive	93	41.46 (10.33)

Anxiety in pregnancy

Anxiety scores vary across socio-demographic variables as shown in Table 2. The mean anxiety scores between women below 35 years of age and women 35 and above were similar (32.41 vs. 32.31). For ethnicity, the mean anxiety scores among Caucasian women versus non-Caucasian women differed by about one point (32.17 vs. 33.24). Education and income both showed a similar downward trend in anxiety scores as education and income levels increased. Women with unsupportive partners had a higher mean anxiety score, by 9.7 points, compared to women with supportive partners. Bivariate analysis revealed no significant differences in anxiety scores for age and ethnicity. Anxiety scores were significantly lower among women with higher levels of education (F (2,1477) = 6.35, p = 0.002) and income (F (3,1476) = 20.27, $p < 0.001$) and supportive partners (t (101.01) = 8.82, $p < 0.001$) relative to women of lower socioeconomic and unsupportive partners.

Research objective 1: Maternal ACES and anxiety

The mean anxiety scores between ACE groups did not differ; pregnant women with ACE scores of 0, 1, 2, 3 and ≥ 4 had mean anxiety scores of 32.7 (SD = 9.23), 32.9 (SD = 9.62), 31.4 (SD = 8.23), 32.5 (SD = 9.86), and 31.6 (SD = 8.33), respectively. In the unadjusted regression model (Model 1), the p-value was statistically significant. This is most likely explained by the large sample size given the effect size is minute. In the adjusted model (Model 2), the association between the maternal ACE score and anxiety score during pregnancy was no longer showed statistical significance. Model 2 was adjusted for income, education, ethnicity, and age (Table 3).

Table 3.3

Linear Regression Models for the Direct Effects of Maternal ACE Score on Anxiety Score During Pregnancy (N = 1,480)[ab]

	Adj R^2	B (95% CI)[b]	*SE*	*p*
Model 1: Unadjusted	0.002			
ACE score		**-0.27 (-0.53, -0.01)**	**0.13**	**0.04**
Model 2: Adjusted	0.040			
ACE score		-0.24 (-0.50, 0.02)	0.13	0.07
Income		**-0.66 (-0.86, -0.46)**	**0.10**	**0.00**
Education		-0.39 (-0.82, 0.05)	0.22	0.08
Ethnicity		0.00 (-0.11, 0.12)	0.06	0.96
Age		0.03 (-0.08, 0.14)	0.06	0.62

[a] Statistically significant variables presented in bold
[b] B = Unstandardized beta weight

Research objective 2

Given the main association between maternal ACEs and anxiety did not show statistical significance, partner support could not be tested as a moderator for the respective association.

3.5 DISCUSSION

In this large sample of pregnant women living in a Canadian urban center, ACEs did not have an impact on maternal anxiety at 34-36 weeks' gestation. In concordance with the present findings, a 2018 study of high socioeconomic status women found a non-significant association between ACEs and anxiety during pregnancy (Menke et al., 2019). The proportion of women with post-secondary education (89.3 vs. 68.0%), who were Caucasian (78.7 vs. 78.4) and partnered (100% vs. 79.9%) were slightly higher in the present study compared to Menke's study sample. Contrary to these non-significant findings, majority of studies have reported a significant association between ACE scores and anxiety (Biaggi et al., 2016; Buist et al., 2011; Racine et al., 2021; Young-Wolff et al., 2019). Among a socioeconomically vulnerable and diverse sample (41.4% = Caucasian, 12.5% = neighborhood median income > $110,000), a dose-response association between maternal ACE scores and anxiety during pregnancy was reported (Young-

Wolff et al., 2019). Buist et al. compared four groups of women and found that women with a history of mental illness, low education, little social support, and child abuse histories were at greater risk for anxiety disorder before and during pregnancy (Buist et al., 2011). Thus, it was deduced by Buist et al. that the main risk of anxiety in pregnancy may be for women who have biological and environmental risks that syndicate with a lack of support (Buist et al., 2011). A 2021 systematic review and meta-analysis by Racine and colleagues reported a significant association between maternal ACE scores and anxiety in pregnancy. Heterogeneity between study findings were reported, suggesting that there may be other social characteristics present that can amplify or attenuate associations (Racine et al., 2021).

The presence of health protective factors might have played a role in producing non-significant results in this specific sample of women, given women with higher education and household incomes had lower anxiety levels compared to pregnant women of lower education and household incomes. These results fit well with a larger body of research that has found high socioeconomic status and its correlates, such as higher education and income, to be health-protective against poor maternal mental illness, including anxiety (Bennett et al., 2004; Littleton et al., 2007). A study by Korotana et al. found this to also be true among adults with childhood adversities (Korotana et al., 2016). Compared to low socioeconomic status, high socioeconomic status environments are often associated with less exposure to hardship and stressors across a lifespan (Matthews & Gallo, 2011). Reduced exposure to stressors results in less hyperactivity of the HPA-axis and lower levels of stress hormones, which are both physiological mechanisms that modulate anxiety symptoms (Cicchetti, 2013). Socioeconomic factors not only impact physiological body responses but can impact the perception of social support received and available. For example, it has been reported in other studies that those who have a higher income

and are part of an ethnic majority may feel more supported relative to those of low socioeconomic status and ethnic minorities (Jesse et al., 2006; Kingston et al., 2011; Van Hulst et al., 2011). It is also likely that women of high socioeconomic status have greater access to social and personal resources that promote resilience and healthy coping strategies to deal with stressors (Matthews & Gallo, 2011). Access to these resources across adulthood likely play a role in shaping positive trajectories of maternal and infant health outcomes (Barban, 2013). Indeed, high socioeconomic factors most likely played a protective role against anxiety among the women in this thesis.

All women in this analysis were partnered and almost all (94%) reported having supportive partners. Mothers with unsupportive partners may be underrepresented, considering the high percentage of supportive partners and given that unsupportive partners were a reason for AOF study withdrawal (Tough et al., 2017). Given the main association was not significant, the modifying role of partner support on the association between maternal ACEs and anxiety during pregnancy could not be investigated. Yet study results indicated that it is possible for supportive partners to function as a protective mechanism against anxiety symptoms at 34-36 weeks' gestation. In the sample under analysis, women with supportive partners had anxiety scores 10 points lower compared to unsupportive partners. The lower anxiety scores among women with supportive partners is consistent with existing research that has found supportive relationships to promote well-being and psychological resilience (Appleton et al., 2019; Ghosh et al., 2010; Lobel et al., 2008; Racine et al., 2018; Rini et al., 2006). Specifically, in a study among the general population it was reported that psychosocial resilience promotes emotional regulation, which in turn protects against symptoms of anxiety associated with ACEs (Poole et al., 2017). The findings from this analysis suggest partner support to be protective but cannot ascertain that

an association exists between partner support and anxiety as it is outside the scope of this analysis.

Strengths and limitations

Strengths of this study include the use of a large dataset of pregnant women that represents a population pregnant mother who are of high socioeconomic status in Canada. The representative of the sample in terms of ethnicity is a strength. Standardized scales were used to measure constructs except for partner support, in which case experts were consulted to help create questions (Tough et al., 2017). Lastly, temporal sequence can be established between the independent and dependent variable in this study given ACEs occurred in childhood and thus preceded maternal anxiety.

The current findings should be considered with several limitations in mind. First, this secondary analysis is based on a cross-sectional design and based entirely on self-report measures. Given data on maternal ACEs were retrospectively collected, study estimates may be subject to recall bias. Yet, researchers have found that documenting ACEs in adulthood produce a low rate of false positives and is a reliable measure (Hardt & Rutter, 2004; Murphy et al., 2014). Given ACE data were collected at the sixth data collection timepoint, there is concern that there was an overrepresentation of healthy and resourceful participants. It was reported in a *AOF* seminal study that participants who continued with the study were older, in stable relationships, more educated, from higher income households, Canadian born and predominantly spoke English at home (Tough et al., 2017). It is likely that women of lower socioeconomical status were underrepresented due to study attrition, thus threatening the generalizability of the present study findings and limiting it to women of high socioeconomic status (Tough et al., 2017). A sample size calculation was not computed for the variables under study because the data for this

secondary data analysis were already collected. The reliability and validity scores of the scale that measured partner support were marginal. Finally, there may have been an overrepresentation of mothers given the way in which questions are phrased in the SSAI (Meades & Ayers, 2011).

3.6 CONCLUSION

Findings from this study, suggest that the association between maternal ACEs and anxiety is not deterministic in nature and that there may be multiple life course factors at play. ACEs may place women at increased vulnerability for anxiety across their lifespan and especially during pregnancy. However, evidence indicates that protective and resilience mechanisms during pregnancy may be able to offset anxiety symptomology at 34-36 weeks' gestation; specifically, the cumulative effect of multiple protective and resilience mechanisms. Further research is required to test the mediating and modifying pathways between ACE and anxiety during pregnancy. Understanding the life course factors that impact this association may help guide interventions to help improve maternal and infant health outcomes.

CHAPTER 4: INVESTIGATING THE ASSOCIATION BETWEEN ADVERSE CHILDHOOD EXPERIENCE AND SMOKING IN PREGNANCY

4.1 INTRODUCTION

Approximately one in ten Canadian women smoke every day, half of whom continue to smoke during their pregnancy (Government of Canada, 2017; Lange et al., 2018). Smoking cigarettes poses a significant threat to the unborn fetus (Gilman et al., 2008; Solomon & Quinn, 2004). Nicotine, tar, and carbon monoxide can directly cross the placenta and impede blood oxygen flow to the fetus, causing adverse effects such as changes in gene patterning, reduced brain growth, and fetal death (Froggatt et al., 2020; McDonnell & Regan, 2019; Roza et al., 2007). Studies have reported a graded association between smoking intensity and the likelihood of miscarriages, stillbirths, pre-term delivery and admission to neonatal intensive care units (NICU) (Smedberg et al., 2014). Smoking during pregnancy places newborns at a 20% increased risk for immediate medical attention or admission to NICU (Adams et al., 2002).

Regardless of these threats to the fetus, some mothers continue to smoke while pregnant. Researchers have identified multiple life course factors that place women at an increased risk of smoking during their pregnancy. For example, women who are single, of low socioeconomic status, and who have a history of mental illness and substance misuse are more likely to smoke during their pregnancy (Al-Sahab et al., 2010; Boucher & Konkle, 2016; Powers et al., 2013; Yang et al., 2017). Women who have experienced childhood adversity are also at increased risk of smoking across their life course, including during pregnancy (Anda et al., 1999; Blalock et al., 2011; Boucher & Konkle, 2016; Chung et al., 2010; Jun et al., 2008; Powers et al., 2013).

ACEs refer to some of the most harmful and recurrent sources of stress that children may experience in early life (World Health Organization, 2020). ACEs broadly consist of multiple

types of abuse, neglect, and household dysfunction; all of which may result in long-lasting trauma and physiological damage (Felitti et al., 1998). Research has found ACEs to result in altered brain structure, circuitry patterns, and dysregulated physiological processes (Shonkoff & Garner, 2012). The visceral impact of ACEs on hyperactivity of the HPA-axis and emotional dysregulation likely contribute to adverse health outcomes in part by the propensity to engage in maladaptive coping strategies, including smoking (Audrain-McGovern et al., 2012; Duffy et al., 2018; Shonkoff & Garner, 2012). Cigarettes can help individuals cope with negative emotions by self-medicating (Allen et al., 2008). In a qualitative study, mothers reported that smoking was a means for them to cope with stress associated with living with multiple disadvantages, such as substance use, mental illness, poverty, history of violence, abuse, and trauma. They also identified smoking as a way to afford them a sense of control over their lives and as a way to manage emotions associated with past adversity and trauma (Martinez Leal et al., 2021).

Robust research illustrates the existence of a graded association between ACEs and early smoking initiation, smoking frequency, and a lifetime of smoking across birth cohorts (Acierno et al., 1996; Anda et al., 1999; Dube et al., 2003; Edwards et al., 2007; Nichols & Harlow, 2004). The strength of the association between an ACE score of 4 or more and smoking among large study samples have shown some variation ranging from weak to moderate (Anda et al., 1999; Bellis et al., 2014; Campbell et al., 2016; Edwards et al., 2007; Felitti et al., 1998; Ford et al., 2011). Relative to the general population, studies examining the association between ACEs and smoking among pregnant mothers are sparse. Preliminary evidence suggests the association between ACEs and smoking would persist among pregnant mothers (Blalock et al., 2011; Chung et al., 2010; Racine et al., 2020). For example, two studies primarily including pregnant women of low socioeconomic status have reported a graded association between maternal childhood

adversity and smoking in pregnancy (Blalock et al., 2011; Chung et al., 2010). More recently a secondary analysis among higher socioeconomic status women reported a strong dose-response association between ACE scores and smoking during pregnancy (Racine et al., 2020). In contrast, a couple of studies have reported a non-significant association between childhood adversity and substance use among the general and perinatal populations (Cosanella et al., 2019; Young-Wolff et al., 2019). The incongruent results reported by researchers merit the investigation of other life course factors that can modify the degree and/or presence of the ACEs-smoking association.

Multiple protective life course factors that can circumvent the negative effects associated with ACEs have been identified (Appleton et al., 2019; Cosanella et al., 2019; Young-Wolff et al., 2019). Specifically, social support has shown to buffer the adverse effects of ACEs on health-risk behaviours among the general and perinatal populations (Appleton et al., 2019; Cohen & Wills, 1985; Misiak et al., 2022; Racine et al., 2018). Two longitudinal studies have found social support to function as a protective factor against the adverse perinatal effects associated with maternal ACEs (Appleton et al., 2019; Racine et al., 2018). Studies illustrate that supportive relationships promote psychosocial well-being and resilience, especially during stressful times (Damron, 2017; Elsenbruch et al., 2006; Misiak et al., 2022; Stubbs et al., 2019). Supportive relationships have shown to reduce stress levels and cigarette cravings, which may have an indirect effect on increasing the success of smoking cessation efforts (Boucher & Konkle, 2016; Elsenbruch et al., 2006; Stubbs et al., 2019). A study with a large representative sample found that pregnant mothers who were partnered were able to significantly reduce their cigarette consumption compared to those without partners (Martin et al., 2007). Overall supportive partner relationships can be impactful in promoting healthy choices and smoking

cessation during pregnancy, but more research is needed to determine whether the negative effects associated with childhood adversity can be moderated by supportive partners (Appleton et al., 2019; Cohen et al., 2016; Jaffee et al., 2017; Pilkington et al., 2015). Smoking strongly correlates with lower socioeconomic status and is a major cause of the health and life expectancy inequalities encountered by women from deprived backgrounds. Pregnant smokers are more likely to be younger, be unemployed, have low educational attainment, have a lack of social support and have increased incidence of mental illness (Tsvetkova et al., 2018). Robust research shows that support relationships can circumvent the adverse effects associated with ACEs, such as risky health taking behaviors (S. Cohen & Wills, 1985; Sperry & Widom, 2013).

Drawing on previous research, the first goal of this study was to examine the impact of ACEs on smoking during pregnancy. Given a graded association between ACEs and smoking has been reported by other researchers, it was hypothesized that a similar association between maternal ACE scores and smoking in pregnancy would exist for this study (Anda et al., 1999; Boucher & Konkle, 2016; Chung et al., 2010; Felitti et al., 1998; Hughes et al., 2019). The second goal of this study was to investigate the modifying effect of partner support on the association between maternal ACEs and smoking if this association is present.

A strong body of research demonstrates that social support buffers adverse effects linked to ACEs, in both the general and perinatal populations (Appleton et al., 2019; Cohen & Wills, 1985; Jaffee et al., 2017; Racine et al., 2018). Thus, it was postulated that partner support would function as an important life course factor that would moderate the maternal ACEs-smoking association. The study objectives are put forward using a life course approach, specifically the impact of social factors during two different sensitive developmental periods: childhood and

pregnancy (Ben-Shlomo & Kuh, 2002). It is conjectured that the effects of ACEs and maternal partner support may be impactful on smoking during pregnancy.

Study objectives

1. To determine if there is an association between maternal ACEs and self-reported smoking at 34-36 weeks' gestation.
2. If present, to examine if the association between maternal ACEs and self-reported smoking is moderated by partner support.

4.2 METHODS

Data collection

Data used in this secondary analysis are from the *All Our Families (AOF)* study. *AOF* is a community-based longitudinal pregnancy cohort study in Calgary, Alberta (McDonald et al., 2013; Tough et al., 2017). The *AOF* study was designed to follow a life course perspective, where mother-child dyads were enrolled from pregnancy and followed across life stages (Tough et al., 2017). Women were eligible to participate in the study if they were 18 years or older, fewer than 25 weeks pregnant, accessing prenatal care in Calgary, Alberta, and fluent in English. From May 2008 to December 2010, 3,387 women were recruited through multiple community channels, such as maternity clinics, a centralized lab service, posters and word of mouth (Tough et al., 2017).

Data collection for the *AOF* study took place over 7 timepoints: less than 25 weeks' gestation, 34-36 weeks' gestation, and at 4 months, and 1, 2, 3, and 5 years post birth (Tough et al., 2017). At each timepoint, participants were mailed a questionnaire (~25 minutes). In the event of repeated non-responders, questionnaires were completed via telephone (Tough et al., 2017). Maternal data used in the present secondary analysis were collected at < 25 weeks'

gestation (socio-demographic characteristics), 34-36 weeks' gestation (maternal smoking habits, partner support), and 3 years post birth (maternal ACE score) (Tough et al., 2017). Honorariums, such as library and grocery gift cards were offered to participants to thank them for completing the questionnaires. Study staff maintained contact with *AOF* participants through congratulation cards upon the arrival of their newborn, semi-annual *AOF* study newsletters, and follow-up contacts in the event of missing data (Tough et al., 2017).

Response rates across data collection timepoints decreased from 99% (N = 3,362) to 69% (N = 1,994) from the first to the sixth timepoint (Tough et al., 2017). Reported reasons for study attrition include ethical approval delays, participant disinterest, time constraints, lack of partner support, loss to follow-up, and residential relocation outside of Calgary, among others. Women who answered all the questions related to maternal ACEs, smoking during pregnancy, partner support and socio-demographic variables were included in this secondary analysis (N = 223).

Measures

Outcome: maternal smoking. Smoking status was measured at 34-36 weeks' gestation by asking mothers: "*Once you knew you were pregnant, how many days per week have you smoked cigarettes (on average)?"* Response options were: 1 = "less than one day", 2 = "one day a week", 3 = "two days a week", 4 = "three days a week", 5 = "four days a week", 6 = "five days a week", 7 = "six days a week" and 8 = "seven days a week". Women who reported that they smoked cigarettes in the 12 months before they got pregnant but reported that they have quit smoking during pregnancy were coded as 0 = 'non-smokers'. Maternal smoking status is known to be under-reported in studies, however it is still deemed as a "fairly accurate" measure with high sensitivity and specificity rates of 85% and 99%, respectively (Arbuckle et al., 2018).

Exposure: adverse childhood experiences. ACE scores were measured using an adapted version of the original ACE checklist created by Felitti and colleagues (Felitti et al., 1998). To measure the exposure of ACEs before 18 years of age, 11 questions were asked. These questions capture events that represent eight categories of ACEs, including emotional abuse (1 question), physical abuse (1 question), sexual abuse (3 questions), domestic violence (1 question), imprisonment of a household member (1 question), separated parents (1 question), caregiver mental illness (1 question) and/or substance abuse in the home (2 questions). Each category was considered as present or absent. Scores from all eight categories were summed and ranged from 0 to 8. ACE scores were categorized into three categories: 0, 1-3, or ≥ 4 ACEs. Data on maternal ACEs were retrospectively collected three years after childbirth at the sixth data collection timepoint. Research shows that collecting ACE scores retrospectively results in a low rate of false positives and satisfactory test-retest reliability (Cammack et al., 2016; Hardt & Rutter, 2004; Murphy et al., 2014). The original ACE scale is considered a reliable measure with a Cronbach's α of 0.88 (Hardt & Rutter, 2004; Murphy et al., 2014). The adapted ACE checklist used in this study had an adequate Cronbach's α value of 0.71 (Vaske et al., 2017).

Effect modifier: partner support. Three items were used to create a partner support score which measured support in three compartments: social/emotional support, practical support, and healthy choices. The first question asked (1) *"How satisfied are you with the social and/or emotional support you receive from your partner?"* and was measured on a 4-point Likert scale ("very satisfied" to "very unsatisfied"). The second and third question asked (2) *"Does your partner provide you with practical support?"* and (3) *"Does your partner support you in making healthy pregnancy choices?"*. The last two questions were measured on a 5-point Likert scale which ranged from "none of the time" to "all of the time". Values from each question were

summed to comprise a total partner support score ranging from 3 to 14, with higher scores indicating greater partner support. This variable was dichotomized into two categories: unsupportive partners (total partner support scores of 10 or lower) and supportive partners (scores of 11 or greater). This measure had a Cronbach's alpha of 0.63, which is considered marginally adequate (Vaske et al., 2017).

Covariates. Socio-demographic information including maternal age, education, income, and pregnancy intent were collected at baseline (Table 1). Maternal age was determined based on self-reported birth date. Maternal education was measured by asking mothers what their highest level of completed education was, with options including "some elementary or high school"; "graduated high school, some college, trade, university"; "graduated college, trade, university"; "some graduate school"; and "completed graduate school". Pregnant mothers were asked to report their "*total income, before taxes and deductions, of all household members from all sources in the past 12 months*". Response options ranged from "less than $10,000" to "more than $100,000". To document whether pregnancies were intended, mothers were asked "*when you became pregnant were you trying to get pregnant?*" with a yes or no response.

Ethics

The Conjoint Health Research Ethics Board at the University of Calgary (Ethics ID 20821 and 22821) approved the *AOF* study. Additional ethical approval for this secondary data analysis was given by the University of Lethbridge Ethics board (Ethics ID 2020-083). Approval to gain access to the database and conduct this secondary data analysis was given by PolicyWise for Children and Families.

4.3 STATISTICAL ANALYSIS

Analysis strategy: sample characteristics

Frequencies were computed for categorical variables (smoking, education, income, pregnancy intent and partner support), while means ± SD were calculated for continuous variables (ACE score, age). Bar charts and histograms were used to visualize data for each variable separately. A bivariate analysis examined trends and patterns between the variables using crosstabs and odds ratios (ORs) with 95% confidence intervals (CIs) for dichotomous variables, and chi-square tests and t-tests for continuous variables or non-binary categorical variables.

Analysis strategy: research objective 1

To examine the association between ACEs and smoking in pregnancy, the two variables were first recoded. ACE scores were measured using a total of 11 questions. First, 8 ACE categories were recoded as present or absent. Questions 1 through 5 had binary (yes/no) response options, which were recoded from 1 = yes and 2 = no to: 1 = present and 0 = absent. Questions 6 through 11 had 3 response options (1 = never, 2 = once, 3 = more than once). These questions were recoded as 1 = present (once or more) and 0 = absent (never) to follow the same coding pattern as questions 1 through 5. More than one question was used to measure two ACE categories: sexual abuse and substance use in the home. In this case, scoring for questions pertaining to each category were summed and a score of ≥ 1 was coded as present = 1 and a score of 0 was coded absent = 0. The sum of all eight categories (e.g., emotional, physical, and/or emotional abuse, domestic violence, imprisonment of household member, separated parents, caregiver mental illness, and/or substance abuse in the home) produced one variable measuring ACEs with a score ranging from 0 to 8. Next, a new variable was created that broke

ACE scores into terciles, which resulted in a final 3-category ACE variable (0 = 0, 1 = 1-3, and 2 = ≥ 4) to be used in the final logistic regression model.

Smoking in pregnancy at 34-36 weeks' gestation was measured by documenting how many days of the week a mother smoked. Coding for the 8 response options were: 1 = "less than one day", 2 = "one day a week", 3 = "two days a week", 4 = "three days a week", 5 = "four days a week", 6 = "five days a week", 7 = "six days a week" and 8 = "seven days a week". Women who reported that they quit smoking at 34-36 weeks' gestation were manually coded as 0 = zero. As a result, scores from the smoking variable ranged from 0-8. To use this variable in the final binary logistic regression model, this variable was categorized into two groups: 0 = women who quit smoking and 1 = women who currently smoke. Next, an unadjusted logistic regression model examined the 3-category ACE variable (0, 1-3, ≥ 4 ACEs) against smoking in pregnancy (0 = no smoking in pregnancy, 1 = smoking in pregnancy) using ORs and 95% CIs. For the binary logistic regression models an ACE score of zero served as the reference category. Significance of the association was determined using 95% CIs. If the CIs included the null value of 1.0, the association was reported as not significant.

In the second logistic regression model the focal association was adjusted for covariates. Covariates for this model were selected *a priori* based on previous research including age, education, income, and pregnancy intent (Chung et al., 2010; Currie & Tough, 2021; Racine et al., 2020). Each of these variables were also tested against the outcome variable (smoking in pregnancy) in separate unadjusted logistic regression models. Those that had a p-value < 0.20 (i.e., a confidence interval of 80%) were retained and included in the final regression model (Bursac et al., 2008). All covariates, except age, met this threshold. Age was retained as a covariate as it is a strong risk factor for health outcomes and is a variable commonly controlled

for. To avoid over fitting models, covariate categories were collapsed when cell sizes were small or when confidence intervals were too wide.

Analysis strategy: research objective 2

The association between maternal ACE score and smoking status must be statistically significant to test whether partner support moderates this association. Assuming the main association shows statical significance, the next step would be to create a multiplicative term between each dummy coded maternal ACE score category (0, 1-3, ≥ 4) and partner support. The multiplicative terms will be included in the regression model as it will provide a means of formally testing the difference between logistic coefficients (Jaccard, 2001). Significance of a multiplicative term is indicative of moderation taking place. In the case that a multiplicative term shows statistical significance ($p < 0.05$), the next step would be to stratify the main regression model by partner support. Stratification of the main regression model by supportive versus unsupportive partners, would have illustrated the heterogeneity of effects of the focal association between the two respective groups (Jaccard, 2001).

After excluding women who did not smoke a cigarette 12 months before they got pregnant the original dataset sample size was reduced from 3,362 to 539 participants. Participants who had missing data for their ACE score, smoking status, partner support or on one or more of the confounders were removed from the analysis using listwise deletion. After using listwise deletion, 41.4% ($N = 223$) of the sample remained as they completed all relevant questions related to the variables examined in this secondary analysis. All analyses were run using SPSS 26.

4.4 RESULTS

Sample characteristics

The sample examined in this chapter was comprised of mature pregnant women who had smoked cigarettes at least once in the 12 months before their pregnancy. The mean age of the sample was 28.9 years (± 4.9, range 18-40 years). As shown in Table 1, the sample was well educated with 70% having at least some post-secondary education. Nearly 70% had an annual household income above $70,000 and about a fourth of the sample had household incomes above the Canadian median of $95,895 (Statistics Canada, 2011a). Pregnancy was intended for approximately 70% of the sample, which is similar to national estimates found by other researchers (Oulman et al., 2015). Of the full study sample, all women were partnered of which approximately 10% were single/separated with a partner, 30% in a living common law partnership and the remaining 60% were married. Most (91.0%) identified as having supportive partners.

Table 4.1

Total Sample Characteristics (N = 223)

Sample Characteristics	Full Sample *n (%)*
Total	223 (100)
Age	
< 35 years	193 (86.5)
≥ 35 years	30 (13.5)
Highest Level of Education Completed	
No post-secondary	67 (30.0)
Post-secondary	156 (70.0)
Income	
< $10,000-$39,999	31 (13.9)
$40,000-$69,999	38 (17.0)
$70,000-$99,999	67 (30.0)
≥ $100,000	87 (39.1)
Pregnancy Intendedness	
Yes	154 (69.1)
No	69 (30.9)
Marital Status	
Single/separated with partner	23 (10.3)
Common-law	71 (31.8)
Married	128 (57.4)
Partner Support	
Supportive partner	203 (91.0)
Unsupportive partner	20 (9.0)
Maternal ACE Mean Score (SD)	1.7 (± 1.9)
Maternal ACEs	
0	86 (38.6)
1-3	99 (44.4)
≥ 4	38 (17.0)
Smoking during Pregnancy	
No smoking while pregnant	69 (30.9)
Occasional smoker (1-3 days per week)	95 (42.6)
Frequent smoker (4-7 days per week)	59 (26.5)

Maternal ACE scores

On a scale of 0 to 8, the mean maternal ACE score was 1.6 (± 1.8, range = 0-7), which is comparable to other studies in North America (Bellis et al., 2014; Merrick et al., 2018). As shown in Table 1, the percentage of women with an ACE score of 0, 1-3, ≥ 4 were 39%, 45%, 17%, respectively. The mean ACE score for women who continued to smoke during their pregnancy was 1.7 (± 1.9, range = 0-7), which was slightly higher but not significantly different from women who quit smoking (1.3 ± 1.4, range = 0-6). There was a statistically significant difference between high and low ACE scores for pregnancy intent, as women who had unintended pregnancy were twice as likely to have an ACE score ≥ 4 (OR 2.07, CI 1.013, 4.23). There was no statistically significant difference between high and low ACE scores for age, education, income, and partner support.

Smoking in pregnancy

All women ($N = 223$) included in this study smoked at least one cigarette in the 12 months before becoming pregnant. As shown in Table 1, approximately one third of the sample quit smoking at the beginning of or during their pregnancy, while just under half of the women smoked occasionally (1-3 days a week), and a quarter smoked frequently (4-7 days a week). Women who smoked occasionally and frequently during their pregnancy were grouped together to create a binary smoking variable for the final logistic regression model (0 = did not smoke during pregnancy, 1 = did smoke during pregnancy).

Individual chi-square tests of independence were performed to examine the association between socio-demographic variables (e.g., age, education, income, pregnancy intent, and partner support) and maternal smoking status. Education (x^2 (1, $N = 223$) = 13.74, $p < 0.001$),

income (x^2 (3, N = 223) = 16.15, p = 0.001) and pregnancy intent (x^2 (1, N = 223) = 12.65, p < 0.001) were all significantly associated with smoking status at 34-36 weeks' gestation. Frequencies showed that more women with lower levels of education, annual household income and unintended pregnancy were more likely to smoke at 34-36 weeks' gestations than their respective counterparts. Individual chi-square tests showed no significance when examining the effect of age and partner support on smoking status at 34-36 weeks' gestation.

Research objective 1

In an unadjusted model, a maternal ACE score above 0 was not associated with an increased odds of smoking in pregnancy among women who had smoked cigarettes before becoming pregnant (Table 2). The association remained non-significant in the adjusted model, which controlled for age, education, income, and pregnancy intent. A mother's education level was significantly associated with her likelihood of smoking in pregnancy. Having no post-secondary education was moderately associated with smoking in pregnancy, with a 2.7 odd increase in smoking when compared to mothers with at least some post-secondary education. Likewise, income level was significant and moderately associated with smoking in pregnancy. Mothers who had an annual household income between $10,000 and $99,999 were about twice as likely to smoke in their pregnancy when compared to mothers who had a household income of $100,000 or more. Among the current sample, the association between maternal pregnancy intent and smoking was statistically significant and moderate. The odds of smoking in pregnancy were 2.5 times greater for women who had an unintended pregnancy compared to women who had an intended pregnancy. The present study findings indicate no post-secondary education, low levels of income, and unintended pregnancy to all serve as significant risk factors for smoking in pregnancy.

Research objective 2

The association between maternal ACE score and smoking status was not statistically significant – consequently, partner support could not be tested for moderation.

Table 4.2

Odds Ratios and Adjusted Odds Ratios (AORs) for Smoking in Pregnancy by ACE Score and by Sample Characteristics (N = 223) [ab]

	%	OR	AOR[b]
ACE Score			
0	37.7	1.0 (Reference)	1.0 (Reference)
1-3	50.7	0.68 (0.35, 1.33)	0.71 (0.34, 1.48)
≥ 4	8.7	2.46 (0.95, 6.34)	1.98 (0.73, 5.36)
Age			
< 35	86.4	1.0 (Reference)	1.0 (Reference)
≥ 35	13.6	1.05 (0.46, 2.43)	1.47 (0.59, 3.66)
Highest Level of Education			
No post-secondary	37.7	**4.03 (1.86, 8.72)**	**2.68 (1.15, 6.26)**
Post-secondary	62.3	1.0 (Reference)	1.0 (Reference)
Income			
< $10,000-$39,999	**16.9**	**4.43 (1.56, 12.59)**	2.38 (0.75, 7.57**)**
$40,000-$69,999	**20.1**	**3.77 (1.50, 9.48)**	2.17 (0.80, 5.90)
$70,000-$99,999	**32.5**	**2.50 (1.25, 5.01)**	**2.33 (1.12, 4.83)**
≥ $100,000	30.5	1.0 (Reference)	1.0 (Reference)
Pregnancy was Intended			
No	**61.7**	**3.66 (1.74, 7.72)**	**2.49 (1.12, 5.53)**
Yes	38.3	1.0 (Reference)	1.0 (Reference)
Partner Support			
Unsupportive	9.1	1.05 (0.39, 2.86)	-
Supportive	90.9	1.0 (Reference)	-

[a] Significant associations are presented in bold using a 95% CI
[b] AOR adjusted for age, education, income, and pregnancy intent

4.5 DISCUSSION

The primary objective of this study was to examine if there is an association between maternal ACE scores and smoking at 34-36 weeks' gestation. The association between maternal ACE scores and smoking was non-significant among the current sample of mature women who smoked in the 12 months before their pregnancy. To date there are very few studies that have reported a non-significant association between ACE scores and smoking including a secondary analysis of 2,604 participants in America (Cosanella et al., 2019). Another study using data from

the Kaiser Permanente Medical Care Program found the association between ACEs and smoking to be insignificant among men but not women (Strine, Edwards, et al., 2012).

In contrast to the present findings, several studies have reported the association between ACEs and smoking to be significant among pregnant women (Blalock et al., 2011; Chung et al., 2010; Racine et al., 2020). Specifically a study by Racine and colleagues using the same dataset as the present study, reported a strong dose-response association between ACE scores and smoking in pregnancy (Racine et al., 2020). Confidence intervals associated with odds ratios reported in the study are wide indicating that there is high variability in the sample. Furthermore, a couple important differences that exist between the present study and the study by Racine and colleagues are: (1) the present study included a specific subsample of pregnant women who smoked at least once in the 12 months before they got pregnant compared to the inclusion of all women who smoked or did not smoke before pregnancy; (2) in the present study, smoking was measured after women knew they were pregnant versus before women knew they were pregnant (Racine et al., 2020). This is an important difference given pregnancy status has been shown to impact mother's smoking status and be a strong motivating factor for mothers to quit smoking during their pregnancy (Breunis et al., 2019; Xu et al., 2013). These differences noted may only partially explain the discrepancy in findings.

It is also possible that the non-significant findings could partly be explained by multiple protective mechanisms at play within the present sample. The sample largely consisted of mature mothers (mean age = 29 ± 4.9), who had post-secondary education (70%), a household income above $70,000 (70%), and supportive partners (91%). Overall, the women in the present study were older, had higher levels of education and income on average compared to two other studies that have found a significant association between childhood adversity and smoking among

pregnant women (Blalock et al., 2011; Chung et al., 2010). For example, a study by Chung and colleagues primarily consisted of young (mean age = 24 ± 6.0) pregnant women who had a personal annual income of $11,758 or less (75%) and had a high school diploma or less (82%) (Chung et al., 2010). Another study comprised of largely young (mean age = 25 ± 4.7) mothers who had an annual family income of $19,999 or less (54%) and had a high school degree or less (68%) (Blalock et al., 2013). On average the annual/personal household income was considerably higher in the present study as well as the percentage of women in the present study who had post-secondary education (38-52%) compared to the two studies mentioned (Chung et al., 2010).

Research has found high socioeconomic status factors to be protective against health-risk behaviours, mental illness, and adverse health outcomes associated with ACEs among the general population (Korotana et al., 2016). High socioeconomic status factors appear to have a similar effect among pregnant mothers, where high income and educational attainment has been associated with a significantly lower likelihood of smoking (Bullock et al., 2001; Scheffers-van Schayck et al., 2019; Yang et al., 2017). Comparable results were obtained in the present study, with higher levels of education and income resulting in decreased levels of risk for smoking compared to their lower education and income counterparts. Furthermore, studies have highlighted high levels of education and income to mediate and modify the pathway between ACEs and substance use (Ben Salah et al., 2020; Cosanella et al., 2019; Lin & Chiao, 2021). Evidence shows that women of high socioeconomic status are less likely to experience frequent hardship compared to those of lower socioeconomic status (Matthews & Gallo, 2011). Research indicates that less hardship results in reduced stress levels, HPA-axis hyperactivity, and greater emotional regulation, all physiological mechanisms that can promote psychosocial well-being

and smoking cessation (Kassel et al., 2003; Matthews & Gallo, 2011). For example, during stressful times nicotine from cigarette smoking may be the most familiar and readily accessible means of relieving distress and providing a sense of control amidst chaos (Kassel et al., 2003). This is further supported by findings from a large (N = 7,210) secondary analysis using Kaiser-Permanente data that identified psychological distress as an intermediate variable between ACEs and smoking among adult women (Strine et al., 2012). It is postulated that psychological distress associated with low socioeconomic status may play a significant role in hindering smoking cessation success (Kassel et al., 2003). Additionally, women of low socioeconomic status are more likely to face additional barriers in trying to access the necessary prenatal care and mental health resources for childhood trauma and/or substance use that may only be provided by private health care services (Cui et al., 2014; Forray, 2016; Härkönen et al., 2018; Stephens et al., 2020). Indeed, women who come from disadvantaged backgrounds are at greater risk for a lifetime of smoking, more likely to start their pregnancy as a smoker, and continue smoking throughout their pregnancy due to a lack of protective life course factors and resiliency sources available (Boucher & Konkle, 2016; Schneider et al., 2010). Thus, given most of the women in this study were of high socioeconomic status it is plausible that the high socioeconomic status of women in the present sample had a protective effect and could explain in part the non-significant findings.

The second objective of this study was to investigate whether partner support moderated the association between maternal ACE scores and smoking in pregnancy. The modifying role of partner support could not be investigated due to the non-significant findings of the main maternal ACEs-smoking association. Unadjusted bivariate analysis illustrates partner support status had no effect on smoking habits among pregnant women. Unsupportive partners were a documented reason for study attrition, thus it is very likely that women with unsupportive partners were

significantly underrepresented in the present study (Tough et al., 2017). Given 91% of the sample reported having supportive partners, it is likely that supportive partners played a protective role in the present study (Cohen et al., 2016; Jaffee et al., 2017). It is postulated that supportive partners may promote emotional regulation and help manage cigarette cravings by providing emotional support during a transformational time in a woman's life (Cohen et al., 2016; Fillo et al., 2019; Ghosh et al., 2010). The present study can make no ascertainments about the impact of partner support on the association between ACEs and smoking in pregnancy, thus more research is needed to study the impact of close relationships on smoking habits linked to ACEs in pregnancy. In combination with high levels of partner support and high socioeconomic status, it is likely that multiple protective and resilience mechanisms had a synergistic effect on the non-significant findings between maternal ACE scores and smoking among the present study sample (Jesse et al., 2006; Matthews & Gallo, 2011; Yang et al., 2017). Multiple life course factors that can modify the ACEs-substance use association among the general population have been identified, but more research is needed to better understand life course factors that can buffer the adverse effect linked to ACEs among pregnant women (Ben Salah et al., 2020; Cosanella et al., 2019; Lin & Chiao, 2021).

Strengths and limitations

Although the sample consisted largely of women with high socioeconomic status, a key strength of this study was the use of a large, otherwise representative sample. Given that ACEs precede smoking during pregnancy, a temporal sequence can be established for this study. All constructs were measured using standardized tools excluding partner support, which was measured using questions developed by the research team with expert consultation (Tough et al., 2017). Other limitations include the use of self-reported data. Findings of this study are based on

retrospectively collected ACE data and thus are subject to recall bias. Yet, other studies have found ACE data reported in adulthood to produce low rates of false positives and therefore are considered to provide valid estimates (Hardt & Rutter, 2004; Murphy et al., 2014). The reader should bear in mind that ACE data were collected at the sixth data collection timepoint and that there is an overrepresentation of healthy and resourceful participants in this study's sample (Tough et al., 2017). An *AOF* study reported that women who were older, in stable relationships, more educated, from higher income households, born in Canada and spoke English at home were more likely to remain in the study (Tough et al., 2017). Given the present study was a secondary data analysis, no sample size calculation was calculated for the variables under study.

4.6 CONCLUSION

Among the present sample of high socioeconomic status women, maternal ACE scores were not significantly associated with smoking at 34-36 weeks' gestation. Even though research has identified ACEs as a robust precursor for smoking over a life course, the present study findings suggest that there may be other protective and resilience mechanisms at play. It is recommended future studies examine the mechanisms that could mediate and modify the pathway between maternal ACEs and smoking in pregnancy. Identifying life course factors that can impact the presence of this association can help tailor interventions targeting to improve maternal and infant health outcomes.

CHAPTER 5: CONCLUSION

Framed by a life course perspective, this thesis examined whether ACEs impacted a) anxiety symptoms, and b) smoking behaviour among pregnant women. Findings of this thesis suggest ACEs do not have an impact on anxiety or smoking in pregnancy. The findings are contrary to what was hypothesized based on existing research. At large, research shows ACEs to significantly increase the likelihood of anxiety symptoms and smoking in adulthood (Anda et al., 1999; Bayrampour et al., 2018; Bellis et al., 2014; Campbell et al., 2016; Edwards et al., 2007; Felitti et al., 1998; Ford et al., 2011; Gallo et al., 2018; Li et al., 2016; Lindert et al., 2014; Racine et al., 2021). Some studies did not find such associations, suggesting the effects of childhood adversity on anxiety and smoking not to be pervasive and not to persist (Blalock et al., 2011; Choi & Sikkema, 2016; Chung et al., 2010; Cosanella et al., 2019; Gilson & Lancaster, 2008; Lindert et al., 2014; Menke et al., 2019). Evidence indicates that there are multiple protective factors across a life course that can circumvent the negative effects linked to ACEs in pregnancy, thus potentially explaining the non-significant thesis findings (Algren et al., 2018; Appleton et al., 2019; Matthews & Gallo, 2011; Poole et al., 2018; Racine et al., 2018; Yang et al., 2017), which are presented below.

ACEs and anxiety in pregnancy

In this thesis, I found no significant association between maternal ACE scores and anxiety at 34-36 weeks' gestation among a mature sample of women with moderate to high socioeconomic status (M = 30.4 years, SD = 4.4). These findings are in contrast to the majority of published studies that have found a statistically significant and positive association between ACEs and anxiety during this period (Bayrampour et al., 2018; Gallo et al., 2018; Li et al., 2016; Lindert et al., 2014; Racine et al., 2021). For example, a 2021 meta-analysis of 5 studies reported

a graded association between ACE scores and anxiety symptoms in pregnancy (Racine et al., 2021). Racine and colleagues found the overall pooled effect of ACEs on anxiety symptoms reported as significant and weak ($r = 0.14$) (Racine et al., 2021). They also reported a variation in the strength of correlation between studies, which could indicate the presence of moderating variables. Findings in the study by Racine and colleagues (2021) suggest that the presence of other life course factors are modifying the strength of association between ACEs and anxiety symptoms.

It is important to note that women in this study, several protective life course factors may have helped to ameliorate the effect of ACEs on anxiety in pregnancy. For this part of my thesis most of the women included in the analysis were Caucasian (78.7%), had at least some post-secondary education (73.0%) and lived in a moderate to high income household earning at least $70,000 or more (77.0%). All women were partnered, and 9 in 10 women reported having supportive partners. It is my contention, and that of others that these factors may provide protection against maternal anxiety despite high ACE scores. Consistent with these ideas, a few studies of women with similarly protective factors have reported non-significant associations between maternal ACEs and anxiety during the perinatal period (Choi & Sikkema, 2016; Gilson & Lancaster, 2008; Menke et al., 2019). For example, Menke et al. (2019) found no association between ACEs and anxiety in a sample of high income women. A study with a large sample of women ($N = 2,793$) found low levels of education and lack of social support to exacerbate the effects of childhood abuse on anxiety in pregnancy (Buist et al., 2011). Multiple systematic reviews have found similar life course factors (e.g., socioeconomic status, social support, and partner relationships) to be influential on maternal mental health during pregnancy (Adhikari et al., 2020; Alipour et al., 2018; Bayrampour et al., 2018; Deklava et al., 2015). Given all women

in the sample were partnered and almost all reported having supportive partners, it may be theorized that the combined effect of strong socioeconomic status and partner support provided protection against anxiety among pregnant women with elevated ACEs in this thesis – as suggested by other authors (Appleton et al., 2019; Buist et al., 2011; Ghosh et al., 2010; Racine et al., 2019; Rini et al., 2006).

ACEs and smoking in pregnancy

This thesis found no significant association between maternal ACE scores and smoking status at 34-36 weeks' gestation *among women who smoked in the 12 months before their pregnancy*. These results are opposite from the results published by most researchers in the field. Most studies have documented a dose-response association between ACEs and smoking later in life (Anda et al., 1999; Bellis et al., 2014; Campbell et al., 2016; Edwards et al., 2007; Felitti et al., 1998; Ford et al., 2011). Varying strengths of the association between an ACE score of 4 or more and smoking in adulthood have been reported, ranging from weak to moderate (Anda et al., 1999; Bellis et al., 2014; Blalock et al., 2011; Campbell et al., 2016; Chung et al., 2010; Edwards et al., 2007; Felitti et al., 1998; Ford et al., 2011; Racine et al., 2020). Similar to my thesis findings, a couple studies have reported non-significant associations between ACEs and smoking (Cosanella et al., 2019; Strine et al., 2012; Young-Wolff et al., 2019). Thus, indicating the association between maternal ACEs and smoking not to be deterministic in nature.

According to a recent systematic review and meta-analysis, socioeconomic status factors such as maternal age, education, and household income, can have a substantial impact on smoking status during pregnancy (Riaz et al., 2018). Like the sub-sample used to examine the ACEs-anxiety association for this thesis, the sub-sample of women included in the analysis for the ACEs-smoking association had multiple health-protective characteristics that likely

circumvented the impact of ACEs on health-risk behaviours, like smoking, in pregnancy. The women in this thesis were generally older, have completed higher levels of education and income compared to two other studies that found a significant association between childhood adversity and smoking among pregnant women (Blalock et al., 2011; Chung et al., 2010). It is reported by other researchers that pregnant women of lower education and income are a vulnerable group who likely face additional challenges in remaining abstinent (Martinez Leal et al., 2021). In a recent qualitative study, mothers explained that smoking was used to cope with stress caused by living with multiple disadvantages, such as mental illness, poverty, history of violence, abuse, and trauma (Martinez Leal et al., 2021). Given that the women included in this thesis were of moderate to high socioeconomic status, they likely had access to support services (e.g., counselling) and alternative means to cope with stress and/or withdrawal symptoms once they discovered they were pregnant (Matthews & Gallo, 2011). It is plausible that the non-significant findings could partly be explained by the moderate to high socioeconomic status characteristics of the sample included in this thesis. Consistent with the present study, a large (N = 2,604) secondary analysis of a low-risk sample also reported a non-significant association between ACE scores and smoking among the general population (Cosanella et al., 2019). Cosanella and colleagues postulated that the high socioeconomic characteristics of their study sample likely protected against the negative effects of ACEs on health-risk behaviours like smoking (Cosanella et al., 2019).

Socioeconomic status and resilience

Prospective life course research illustrates socioeconomic status as an origin of lifestyle behaviours and subsequent health outcomes across a lifespan (Dalstra et al., 2005; Hosseinpoor et al., 2012; Kivimäki et al., 2020; Van Minh et al., 2008; Wang & Geng, 2019). Preliminary

findings of my thesis suggest women with lower education and income to have significantly higher mean anxiety scores (mean difference = 3.14-6.08) and odds of smoking (OR = 2.26-2.38) compared to their higher educated and more affluent counterparts. This falls in line with existing evidence illustrating those from disadvantaged backgrounds to have an increased risk of experiencing anxiety symptoms and smoking in pregnancy compared to those of higher socioeconomic status (Bullock et al., 2001; Cena et al., 2020; Kivimäki et al., 2020; Nasreen et al., 2011; Scheffers-van Schayck et al., 2019; Wang & Geng, 2019; Yang et al., 2017). Studies have also found women of low socioeconomic status to be more likely to experience frequent hardship, material deprivation and higher levels of stress compared to those of higher socioeconomic status (Algren et al., 2018; Dalstra et al., 2005; Martikainen et al., 2003; Matthews & Gallo, 2011; Van Minh et al., 2008; Verbeek et al., 2019). Elevated stress results in HPA-axis hyperactivity and emotional dysregulation, both physiological mechanisms that can amplify anxiety symptoms and smoking cravings (Algren et al., 2018; Kassel et al., 2003; Littleton et al., 2007; Matthews & Gallo, 2011; Molarius et al., 2009). Stress linked to aspects of low socioeconomic status has been found to exacerbate the negative effects of trauma and adversity across a lifespan (e.g., low income, education, and unemployment) (Lin & Chiao, 2021; Verbeek et al., 2019).

High socioeconomic environments have been associated with greater access to social and personal resources that promote healthy coping strategies, compared to low socioeconomic environments (Algren et al., 2018; Matthews & Gallo, 2011; Yang et al., 2017). Evidence shows that access to mental health resources, such as therapy, can help individuals cope with childhood trauma, substance misuse, and/or anxiety (Knekt et al., 2015; Sloan et al., 2018). Therapy in pregnancy primarily involves behavioural counselling which may require significant personal

and financial resources to participate in (Forray, 2016; Thomas et al., 2014). Such mental health resources are generally not covered by public healthcare or insurance plans in Canada, and therefore is only accessible to those who can afford it (Cohen & Peachey, 2014). Access to counselling can promote psychosocial well-being and resilience (Ungar & Liebenberg, 2011). Resilience refers to an individual's adaptive ability to cope with change, process difficult feelings, and recover from adversity (Young-Wolff et al., 2019). Resilience research shows that beneficial experiences, such as supportive relationships, can also promote emotional regulation and mental well-being (Bellis et al., 2017; Cohen et al., 2016; Cohen & Wills, 1985; Narayan et al., 2018; Perreira et al., 2019; Racine et al., 2018); both of which, can play an integral role in protecting against maternal anxiety symptoms and smoking linked to ACEs (Gilman et al., 2008; Perreira et al., 2019; Poole et al., 2018; Schneider et al., 2010; Stubbs et al., 2019; Wray et al., 2013). Altogether, the sample used for this thesis had many health-protective characteristics, which likely promoted resiliency and mental well-being.

Partner support and resilience

This thesis was not able to examine the modifying impact of partner support on the association between ACEs and both, anxiety, and smoking in pregnancy due to the non-significant findings. Considering that almost all women perceived their partners as supportive, it is likely that partner support also had a protective effect against anxiety and smoking among the sample of pregnant women included in my thesis. For instance, positive and meaningful connections with a partner have consistently been associated with higher levels of happiness, self-esteem, and fulfilment – buffering against adverse health effects linked to stress (Chao, 2011; Lakey, 2013). Indeed, those who experience positive relationships tend to report greater mental well-being and higher rates of positive affect (Finch et al., 1999; Lakey et al., 2016).

Supportive relationships have also shown to lower stress levels by promoting emotional regulation and psychosocial resilience, subsequently protecting against anxiety symptoms and cigarette cravings (Cohen et al., 2016; Fillo et al., 2019; Ghosh et al., 2010; Poole et al., 2018). Relationships are in many ways important for mental well-being (Turner & Turner, 2013). Social support is a protective factor that acts as a buffer in situations of psychosocial crisis and adversity (Ahmadi, 2015; Molarius et al., 2009). Thus, many health protective characteristics likely played a role in the findings for this thesis.

Sources of resilience following ACEs

There are various life course factors that could circumvent the negative effects of mental and physical well-being following childhood adversity (Afifi et al., 2022; Cheung et al., 2017, 2018; Logan-Greene et al., 2014). Research has found school engagement, emotional closeness, perspective taking, and future-oriented thinking to result in greater mental well-being and health promotive behaviours (Afifi et al., 2022; Cheung et al., 2017, 2018). Youth who are committed to school, involved in school activities, achievements, and have caring teachers may receive more support and have more self-confidence, subsequently promoting well-being (Cheung et al., 2017). In terms of emotional closeness, supportive relationships such as having a close friend or trusted adult, can increase abused youth's ability to cope (Cheung et al., 2017). A close friend or trusted adult who practices empathic listening can help youth feel safe, understood, and accepted. Empathic listening from an adult can also create a safe space for collaborative problem solving and opportunity for perspective taking as well as future-oriented thinking (Eskritt et al., 2014; Häggström Westberg et al., 2019). Future-oriented thinking encourages reflective decision-making in adolescence and promote optimism for the future by setting goals and making plans to achieve those goals (Eskritt et al., 2014; Häggström Westberg et al., 2019). School engagement,

emotional closeness, perspective taking, and future-oriented thinking are all factors that foster resilience among youth, reducing the likelihood of mental illness and substance use (Afifi et al., 2022; Cheung et al., 2017, 2018). It is possible that some of these life course factors were present during adolescence for some of the women included in the secondary analysis of this thesis.

Thesis limitations

Findings of this thesis should be considered with several limitations in mind. First, all data utilized in the secondary analyses were self-reported. ACE data were retrospectively collected; thus, findings of this thesis are subject to recall bias. Yet, studies have shown retrospectively collected ACE data to remain a reliable measure producing valid estimates and low rates of false positives (Hardt & Rutter, 2004; Murphy et al., 2014). If ACE data were collected earlier in the *AOF* study, findings may have resulted in a more representative sample and produced different results. This thesis only examined the cumulative effect of ACEs on pregnancy outcomes and not the impact of specific ACE subtypes on pregnancy outcomes. All constructs were measured using standardized tools except for partner support.

In the AOF study experts were involved in the development of the three questions used to measure partner support (Tough et al., 2017). The three questions individually measured one of the following types of support: emotional, practical, and healthy lifestyle. The response from each question was measured on a Likert scale comprising a total score ranging from 3 to 14. The Cronbach's alpha indicates low internal consistency for this scale in this thesis. A low alpha value could be explained by a small number of questions or poor inter-relatedness between questions (Tavakol & Dennick, 2011). Measuring partner support in pregnancy lacks rigor. Researchers have used various scales to measure this construct resulting in study findings that are difficult to compare (Pilkington et al., 2015). One question or a combination of questions

have been used to measure partner support (Ghosh et al., 2010; Racine et al., 2019; Rini et al., 2006); where others have used validated scales or adapted standardized scales (e.g., *Relationship Questionnaire*, *Social Support Effectiveness Scale*, *Norbeck Social Support Questionnaire* and *Postpartum Partner Support Scale*) (Cheng et al., 2016; Cohen et al., 2016; Pilkington et al., 2015; Stapleton et al., 2012).

Pregnant women with unsupportive partners were likely underrepresented in this thesis. Less than 10% reported having unsupportive partners and unsupportive partners were a documented reason for study attrition in the larger *AOF* study (Tough et al., 2017). Participants who remained in the *AOF* study were reported to be older, more educated, have a higher household income, Canadian born, fluent in English and in stable relationships (Tough et al., 2017). Given that women from disadvantaged backgrounds (e.g., younger, uneducated, from lower income households etc.) were less likely to remain in the study, low socioeconomic status women were also underrepresented. To account for an overrepresentation of high socioeconomic status characteristics, socioeconomic status variables were entered into statistical models as covariates. Yet, residual confounding likely remained after adjustment of socioeconomic status characteristics given the source population consisted of women of high socioeconomic status – consequently resulting in an imperfect adjustment and selection bias (Szklo & Nieto, 2018). Covariates for all statistical models were carefully selected *a priori* and based on existing literature. Lastly, the present study was a secondary data analysis, therefore no sample size calculation was done.

Future research directions

Understanding the risk factors for maternal anxiety and smoking in pregnancy is important for prevention of adverse pregnancy outcomes. The non-significant findings bring

attention to the impact of maternal ACEs on anxiety and smoking in pregnancy across the socioeconomic spectrum (Biaggi et al., 2016; Buist et al., 2011; Xu et al., 2013; Yang et al., 2017; Young-Wolff et al., 2019). To determine whether higher socioeconomic status can circumvent the adverse effects of ACEs on mental well-being and substance use among pregnant mothers, it is recommended for studies to test moderating pathways. Being able to identify moderators of the association between ACEs and pregnancy outcomes can help explain "when" and "for whom" associations are stronger or weaker.

Future researchers should consider the risk and benefits of both cross-sectional and longitudinal studies. Given women of lower socioeconomic status may face additional barriers to continue participation in longitudinal cohort studies, it may be worth considering the use of a cross-sectional or short-term longitudinal design where study commitment is low. Longitudinal studies are superior to cross-sectional study designs, however cross-sectional studies are sufficient in collecting prevalence data and may increase the likelihood of recruiting a representative sample (Kesmodel, 2018; Szklo & Nieto, 2018). Due to pregnancy being a transitional time in a women's life, researchers have noted some challenges with recruiting pregnant women (Admon et al., 2016; Blehar et al., 2013; Kesmodel, 2018). Recruitment challenges in perinatal research could be avoided by increasing the visibility of research in social media, which could promote study access, sampling frame, and ultimately reduce the threat of selection bias (Admon et al., 2016; Blehar et al., 2013; Kesmodel, 2018). Given that anxiety symptoms and smoking status can change across trimesters, it is important for researchers to ensure anxiety symptoms and smoking status are measured in the same stage of pregnancy for all participants (Breunis et al., 2019; Madhavanprabhakaran et al., 2015; Racine et al., 2021; Xu et al., 2013). In an effort to better understand the moderating and mediating pathways of resilience

between ACEs and health outcomes, researchers have called for the use of mixed-method approaches and the inclusion of strength-based questions in ACE studies (Leitch, 2017).

Conclusion

In contrast to previous studies, this thesis found maternal ACE score was not associated with anxiety or smoking during pregnancy (Audrain-McGovern et al., 2012; Duffy et al., 2018; Hofmann et al., 2012; Shonkoff & Garner, 2012). Yet, these findings add to a growing body of evidence that suggests there may be important protective factors that may help to ameliorate the adverse impacts of childhood ACEs on a women's mental health and health behaviour in pregnancy. It is important to note that the generalizability of the findings of this thesis are limited to low-risk samples of women. From a life course perspective, health outcomes are the result of the cumulative risk and protective factors an individual is exposed to across a lifespan (Halfon & Hochstein, 2002). Although the current study cannot ascertain the cumulative role of any specific life course factors, it is postulated based on existing research that the moderate to high socioeconomic status characteristics of the study sample are health protective and could play a key role in explaining the non-significant findings (Dalstra et al., 2005; Hosseinpoor et al., 2012; Kivimäki et al., 2020; Van Minh et al., 2008; Wang & Geng, 2019). Importantly, the observed associations are not deterministic. Thus, not all pregnant women who were exposed to ACEs developed anxiety symptoms or smoke during pregnancy.

REFERENCES

Abraham, M., Alramadhan, S., Iniguez, C., Duijts, L., Jaddoe, V. W., Den Dekker, H. T., Crozier, S., Godfrey, K. M., Hindmarsh, P., Vik, T., Jacobsen, G. W., Hanke, W., Sobala, W., Devereux, G., & Turner, S. (2017). A systematic review of maternal smoking during pregnancy and fetal measurements with meta-analysis. *PLoS One*, *12*(2), e0170946. https://doi.org/10.1371/journal.pone.0170946

Acierno, R., Kilpatrick, D. G., Resnick, H. S., Saunders, B. E., & Best, C. L. (1996). Violent assault, posttraumatic stress disorder, and depression: risk factors for cigarette use among adult women. *Behavior Modification*, *20*(4), 363-384. https://doi.org/10.1177/01454455960204001

Adhikari, K., Patten, S. B., Williamson, T., Patel, A. B., Premji, S., Tough, S., Letourneau, N., Giesbrecht, G., & Metcalfe, A. (2020). Neighbourhood socioeconomic status modifies the association between anxiety and depression during pregnancy and preterm birth: a Community-based Canadian cohort study. *BMJ Open*, *10*(2), e031035. https://doi.org/10.1136/bmjopen-2019-031035

Admon, L., Haefner, J. K., Kolenic, G. E., Chang, T., Davis, M. M., & Moniz, M. H. (2016). Recruiting pregnant patients for survey research: a head to head comparison of social media-based versus clinic-based approaches. *Journal of Medical Internet Research*, *18*(12), e326. https://doi.org/10.2196/jmir.6593

Afifi, T. O., Taillieu, T., Salmon, S., Stewart-Tufescu, A., Struck, S., Fortier, J., MacMillan, H. L., Sareen, J., Tonmyr, L., & Katz, L. Y. (2022). Protective factors for decreasing nicotine, alcohol, and cannabis use among adolescents with a history of Adverse Childhood Experiences (ACEs). *International Journal of Mental Health and Addiction*. https://doi.org/10.1007/s11469-021-00720-x

Ahmadi, A. (2015). Social support and women's health. *Women's Health Bulletin*, *3*(1). https://doi.org/10.17795/whb-31083

Al-Sahab, B., Saqib, M., Hauser, G., & Tamim, H. (2010). Prevalence of smoking during pregnancy and associated risk factors among Canadian women: a national survey. *BMC Pregnancy and Childbirth*, *10*(1), 24. https://doi.org/10.1186/1471-2393-10-24

Alcalá, H. E., von Ehrenstein, O. S., & Tomiyama, A. J. (2016). Adverse childhood experiences and use of cigarettes and smokeless tobacco products. *J Community Health*, *41*(5), 969-976. https://doi.org/10.1007/s10900-016-0179-5

Algren, M. H., Ekholm, O., Nielsen, L., Ersbøll, A. K., Bak, C. K., & Andersen, P. T. (2018). Associations between perceived stress, socioeconomic status, and health-risk behaviour in deprived neighbourhoods in Denmark: a cross-sectional study. *BMC Public Health*, *18*(1). https://doi.org/10.1186/s12889-018-5170-x

Alio, A. P., Lewis, C. A., Scarborough, K., Harris, K., & Fiscella, K. (2013). A community perspective on the role of fathers during pregnancy: a qualitative study. *BMC Pregnancy Childbirth*, *13*, 60. https://doi.org/10.1186/1471-2393-13-60

Alipour, Z., Kheirabadi, G. R., Kazemi, A., & Fooladi, M. (2018). The most important risk factors affecting mental health during pregnancy: a systematic review [Facteurs de risque les plus importants affectant la santé mentale pendant la grossesse : analyse systématique]. *Eastern Mediterranean Health Journal*, *24*(6), 549-559. https://doi.org/http://dx.doi.org/10.26719/2018.24.6.549

Allen, S. S., Bade, T., Hatsukami, D., & Center, B. (2008). Craving, withdrawal, and smoking urges on days immediately prior to smoking relapse. *Nicotine & Tobacco Research*, *10*(1), 35-45. https://doi.org/10.1080/14622200701705076

Ananth, C. V., & Schisterman, E. F. (2017). Confounding, causality, and confusion: the role of intermediate variables in interpreting observational studies in obstetrics. *Am J Obstet Gynecol*, *217*(2), 167-175. https://doi.org/10.1016/j.ajog.2017.04.016

Anctil, T. M., McCubbin, L. D., O'Brien, K., & Pecora, P. (2007). An evaluation of recovery factors for foster care alumni with physical or psychiatric impairments: Predictors of psychological outcomes. *Children and Youth Services Review*, *29*(8), 1021-1034. https://doi.org/https://doi.org/10.1016/j.childyouth.2007.02.003

Anda, R. F., Croft, J. B., Felitti, V. J., Nordenberg, D., Giles, W. H., Williamson, D. F., & Giovino, G. A. (1999). Adverse childhood experiences and smoking during adolescence and adulthood. *Jama*, *282*(17), 1652-1658. https://doi.org/10.1001/jama.282.17.1652

Anda, R. F., Felitti, V. J., Bremner, J. D., Walker, J. D., Whitfield, C., Perry, B. D., Dube, S. R., & Giles, W. H. (2006). The enduring effects of abuse and related adverse experiences in childhood. A convergence of evidence from neurobiology and epidemiology. *Eur Arch Psychiatry Clin Neurosci*, *256*(3), 174-186. https://doi.org/10.1007/s00406-005-0624-4

Anderson, T. M., Lavista Ferres, J. M., Ren, S. Y., Moon, R. Y., Goldstein, R. D., Ramirez, J. M., & Mitchell, E. A. (2019). Maternal smoking before and during pregnancy and the risk of sudden unexpected infant death. *Pediatrics*, *143*(4). https://doi.org/10.1542/peds.2018-3325

Andersson, I. M., Nilsson, S., & Adolfsson, A. (2012). How women who have experienced one or more miscarriages manage their feelings and emotions when they become pregnant again - a qualitative interview study. *Scand J Caring Sci*, *26*(2), 262-270. https://doi.org/10.1111/j.1471-6712.2011.00927.x

Appleton, A. A., Kiley, K., Holdsworth, E. A., & Schell, L. M. (2019). Social support during pregnancy modifies the association between maternal adverse childhood experiences and infant birth size. *Maternal Child Health Journal*, *23*(3), 408-415. https://doi.org/10.1007/s10995-018-02706-z

Arbuckle, T. E., Liang, C. L., Fisher, M., Caron, N. J., & Fraser, W. D. (2018). Exposure to tobacco smoke and validation of smoking status during pregnancy in the MIREC study. *J Expo Sci Environ Epidemiol*, *28*(5), 461-469. https://doi.org/10.1038/s41370-017-0011-z

Audrain-McGovern, J., Rodriguez, D., Leventhal, A. M., Cuevas, J., Rodgers, K., & Sass, J. (2012). Where is the pleasure in that? Low hedonic capacity predicts smoking onset and escalation. *Nicotine Tob Res*, *14*(10), 1187-1196. https://doi.org/10.1093/ntr/nts017

Barban, N. (2013). Family trajectories and health: a life course perspective. *European Journal of Population*, *29*(4), 357-385. https://doi.org/10.1007/s10680-013-9296-3

Bayrampour, H., Ali, E., McNeil, D. A., Benzies, K., MacQueen, G., & Tough, S. (2016). Pregnancy-related anxiety: a concept analysis. *Int J Nurs Stud*, *55*, 115-130. https://doi.org/10.1016/j.ijnurstu.2015.10.023

Bayrampour, H., McDonald, S., & Tough, S. (2015). Risk factors of transient and persistent anxiety during pregnancy. *Midwifery*, *31*(6), 582-589. https://doi.org/10.1016/j.midw.2015.02.009

Bayrampour, H., Vinturache, A., Hetherington, E., Lorenzetti, D. L., & Tough, S. (2018). Risk factors for antenatal anxiety: a systematic review of the literature. *Journal of Reproductive and Infant Psychology*, *36*(5), 476-503. https://doi.org/10.1080/02646838.2018.1492097

Bellis, M. A., Hardcastle, K., Ford, K., Hughes, K., Ashton, K., Quigg, Z., & Butler, N. (2017). Does continuous trusted adult support in childhood impart life-course resilience against adverse childhood experiences - a retrospective study on adult health-harming behaviours and mental well-being. *BMC psychiatry*, *17*(1), 110-110. https://doi.org/10.1186/s12888-017-1260-z

Bellis, M. A., Hughes, K., Ford, K., Ramos Rodriguez, G., Sethi, D., & Passmore, J. (2019). Life course health consequences and associated annual costs of adverse childhood experiences across Europe and North America: a systematic review and meta-analysis. *Lancet Public Health*, *4*(10), e517-e528. https://doi.org/10.1016/s2468-2667(19)30145-8

Bellis, M. A., Hughes, K., Leckenby, N., Perkins, C., & Lowey, H. (2014). National household survey of adverse childhood experiences and their relationship with resilience to health-harming behaviors in England. *BMC Medicine*, *12*(1), 72. https://doi.org/10.1186/1741-7015-12-72

Ben Salah, A., Nakajima, M., DeAngelis, B. N., & al'Absi, M. (2020). Effects of tobacco addiction on links between early life adversities, sleep disturbance, and depression: A moderated mediation approach. *Preventive Medicine Reports*, *20*, 101225. https://doi.org/https://doi.org/10.1016/j.pmedr.2020.101225

Ben-Shlomo, Y., & Kuh, D. (2002). A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. *International Journal of Epidemiology*, *31*(2), 285-293. https://doi.org/10.1093/ije/31.2.285

Bennett, H. A., Einarson, A., Taddio, A., Koren, G., & Einarson, T. R. (2004). Prevalence of depression during pregnancy: systematic review. *Obstetrics & Gynecology*, *103*(4), 698-709. https://doi.org/10.1097/01.AOG.0000116689.75396.5f

Benowitz, N. L. (2010). Nicotine addiction. *The New England journal of medicine*, *362*(24), 2295-2303. https://doi.org/10.1056/NEJMra0809890

Berens, A. E., Jensen, S. K. G., & Nelson, C. A. (2017). Biological embedding of childhood adversity: from physiological mechanisms to clinical implications. *BMC Medicine*, *15*(1), 135. https://doi.org/10.1186/s12916-017-0895-4

Biaggi, A., Conroy, S., Pawlby, S., & Pariante, C. M. (2016). Identifying the women at risk of antenatal anxiety and depression: a systematic review. *J Affect Disord*, *191*, 62-77. https://doi.org/10.1016/j.jad.2015.11.014

Blalock, J. A., Minnix, J. A., Mathew, A. R., Wetter, D. W., McCullough, J. P., & Cinciripini, P. M. (2013). Relationship of childhood trauma to depression and smoking outcomes in pregnant smokers. *J Consult Clin Psychol*, *81*(5), 821-830. https://doi.org/10.1037/a0033381

Blalock, J. A., Nayak, N., Wetter, D. W., Schreindorfer, L., Minnix, J. A., Canul, J., & Cinciripini, P. M. (2011). The relationship of childhood trauma to nicotine dependence in pregnant smokers. *Psychol Addict Behav*, *25*(4), 652-663. https://doi.org/10.1037/a0025529

Blehar, M. C., Spong, C., Grady, C., Goldkind, S. F., Sahin, L., & Clayton, J. A. (2013). Enrolling pregnant women: issues in clinical research. *Womens Health Issues*, *23*(1), e39-45. https://doi.org/10.1016/j.whi.2012.10.003

Boucher, J., & Konkle, A. T. (2016). Understanding inequalities of maternal smoking—bridging the gap with adapted intervention strategies. *Int J Environ Res Public Health*, *13*(3). https://doi.org/10.3390/ijerph13030282

Breunis, L. J., Been, J. V., de Jong-Potjer, L., Steegers, E. A., de Beaufort, I. D., de Kroon, M. L., & Ismaili M'hamdi, H. (2019). Incentives for smoking cessation during pregnancy: an ethical framework. *Nicotine & Tobacco Research*, *22*(9), 1553-1559. https://doi.org/10.1093/ntr/ntz231

Brockington, I. F., Macdonald, E., & Wainscott, G. (2006). Anxiety, obsessions and morbid preoccupations in pregnancy and the puerperium. *Archives of Women's Mental Health*, *9*(5), 253-263. https://doi.org/10.1007/s00737-006-0134-z

Buist, A., Gotman, N., & Yonkers, K. A. (2011). Generalized anxiety disorder: course and risk factors in pregnancy. *J Affect Disord*, *131*(1-3), 277-283. https://doi.org/10.1016/j.jad.2011.01.003

Bullock, L. F., Mears, J. L., Woodcock, C., & Record, R. (2001). Retrospective study of the association of stress and smoking during pregnancy in rural women. *Addict Behav*, *26*(3), 405-413. https://doi.org/10.1016/s0306-4603(00)00118-0

Bursac, Z., Gauss, C. H., Williams, D. K., & Hosmer, D. W. (2008). Purposeful selection of variables in logistic regression. *Source Code for Biology and Medicine*, *3*(1), 17. https://doi.org/10.1186/1751-0473-3-17

Butler, E. A., & Randall, A. K. (2012). Emotional coregulation in close relationships. *Emotion Review*, *5*(2), 202-210. https://doi.org/10.1177/1754073912451630

Cammack, A. L., Hogue, C. J., Drews-Botsch, C. D., Kramer, M. R., Pearce, B. D., Knight, B. T., Stowe, Z. N., & Newport, D. J. (2016). Test-retest reliability of retrospective self-

reported maternal exposure to childhood abuse and neglect. *Arch Womens Ment Health*, *19*(2), 415-421. https://doi.org/10.1007/s00737-015-0536-x

Campbell, J. A., Walker, R. J., & Egede, L. E. (2016). Associations between adverse childhood experiences, high-risk behaviors, and morbidity in adulthood. *Am J Prev Med*, *50*(3), 344-352. https://doi.org/10.1016/j.amepre.2015.07.022

Carr, C. P., Martins, C. M., Stingel, A. M., Lemgruber, V. B., & Juruena, M. F. (2013). The role of early life stress in adult psychiatric disorders: a systematic review according to childhood trauma subtypes. *J Nerv Ment Dis*, *201*(12), 1007-1020. https://doi.org/10.1097/nmd.0000000000000049

Cena, L., Mirabella, F., Palumbo, G., Gigantesco, A., Trainini, A., & Stefana, A. (2020). Prevalence of maternal antenatal anxiety and its association with demographic and socioeconomic factors: a multicentre study in Italy. *European Psychiatry*, *63*(1), 1-16. https://doi.org/10.1192/j.eurpsy.2020.82

Chamberlain, C., O'Mara-Eves, A., Porter, J., Coleman, T., Perlen, S. M., Thomas, J., & McKenzie, J. E. (2017). Psychosocial interventions for supporting women to stop smoking in pregnancy. *Cochrane Database of Systematic Reviews*, *2020*(3). https://doi.org/10.1002/14651858.cd001055.pub5

Chao, R. C.-L. (2011). Managing stress and maintaining well-being: social support, problem-focused coping, and avoidant coping. *Journal of Counseling & Development*, *89*(3), 338-348. https://doi.org/https://doi.org/10.1002/j.1556-6678.2011.tb00098.x

Cheng, E. R., Rifas-Shiman, S. L., Perkins, M. E., Rich-Edwards, J. W., Gillman, M. W., Wright, R., & Taveras, E. M. (2016). The influence of antenatal partner support on pregnancy outcomes. *J Womens Health (Larchmt)*, *25*(7), 672-679. https://doi.org/10.1089/jwh.2015.5462

Cheung, K., Taillieu, T., Turner, S., Fortier, J., Sareen, J., MacMillan, H. L., Boyle, M. H., & Afifi, T. O. (2017). Relationship and community factors related to better mental health following child maltreatment among adolescents. *Child Abuse & Neglect*, *70*, 377-387. https://doi.org/https://doi.org/10.1016/j.chiabu.2017.06.026

Cheung, K., Taillieu, T., Turner, S., Fortier, J., Sareen, J., MacMillan, H. L., Boyle, M. H., & Afifi, T. O. (2018). Individual-level factors related to better mental health outcomes following child maltreatment among adolescents. *Child Abuse & Neglect*, *79*, 192-202. https://doi.org/https://doi.org/10.1016/j.chiabu.2018.02.007

Choi, K. W., & Sikkema, K. J. (2016). Childhood maltreatment and perinatal mood and anxiety disorders: a systematic review. *Trauma Violence Abuse*, *17*(5), 427-453. https://doi.org/10.1177/1524838015584369

Chung, E. K., Nurmohamed, L., Mathew, L., Elo, I. T., Coyne, J. C., & Culhane, J. F. (2010). Risky health behaviors among mothers-to-be: the impact of adverse childhood experiences. *Acad Pediatr*, *10*(4), 245-251. https://doi.org/10.1016/j.acap.2010.04.003

Cicchetti, D. (2013). Annual research review: resilient functioning in maltreated children – past, present, and future perspectives. *Journal of Child Psychology and Psychiatry*, *54*(4), 402-422. https://doi.org/https://doi.org/10.1111/j.1469-7610.2012.02608.x

Cnattingius, S. (2004). The epidemiology of smoking during pregnancy: smoking prevalence, maternal characteristics, and pregnancy outcomes. *Nicotine & Tobacco Research*, *6*(Suppl_2), S125-S140. https://doi.org/10.1080/14622200410001669187

Cohen, K., Capponi, S., Nyamukapa, M., Baxter, J., Crawford, A., & Worly, B. (2016). Partner involvement during pregnancy and maternal health behaviors. *Maternal and Child Health Journal*, *20*(11), 2291-2298. https://doi.org/10.1007/s10995-016-2048-3

Cohen, K. R., & Peachey, D. (2014). Access to psychological services for Canadians: getting what works to work for Canada's mental and behavioural health. *Canadian psychology = Psychologie canadienne*, *55*(2), 126-130. https://doi.org/10.1037/a0036499

Cohen, S., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological bulletin*, *98*(2), 310-357. https://doi.org/10.1037/0033-2909.98.2.310

Cosanella, T., Youkhaneh, N., Bennett, N., & Morrell, H. E. R. (2019). Demographic moderators of the relationship between adverse childhood experiences and cigarette smoking. *Substance Use & Misuse*, *54*(13), 2229-2240. https://doi.org/10.1080/10826084.2019.1642358

Cui, Y., Shooshtari, S., Forget, E. L., Clara, I., & Cheung, K. F. (2014). Smoking during pregnancy: findings from the 2009-2010 Canadian Community Health Survey. *PLoS One*, *9*(1), e84640. https://doi.org/10.1371/journal.pone.0084640

Currie, C. L., Sanders, J. L., Swanepoel, L. M., & Davies, C. M. (2020). Maternal adverse childhood experiences are associated with binge drinking during pregnancy in a dose-dependent pattern: findings from the All Our Families cohort. *Child Abuse Negl*, *101*, 104348. https://doi.org/10.1016/j.chiabu.2019.104348

Currie, C. L., & Tough, S. C. (2021). Adverse childhood experiences are associated with illicit drug use among pregnant women with middle to high socioeconomic status: findings from the All Our Families Cohort. *BMC Pregnancy and Childbirth*, *21*(1), 133-133. https://doi.org/10.1186/s12884-021-03591-1

Dalstra, J., Kunst, A., Borrell, C., Breeze, E., Cambois, E., Costa, G., Geurts, J., Lahelma, E., Van Oyen, H., Rasmussen, N., Regidor, E., Spadea, T., & Mackenbach, J. (2005). Socioeconomic differences in the prevalence of common chronic diseases: an overview of eight European countries. *International Journal of Epidemiology*, *34*(2), 316-326. https://doi.org/10.1093/ije/dyh386

Damron, K. R. (2017). Review of the relationships among psychosocial stress, secondhand smoke, and perinatal smoking. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, *46*(3), 325-333. https://doi.org/https://doi.org/10.1016/j.jogn.2017.01.012

Danese, A., Moffitt, T. E., Harrington, H., Milne, B. J., Polanczyk, G., Pariante, C. M., Poulton, R., & Caspi, A. (2009). Adverse childhood experiences and adult risk factors for age-related disease: depression, inflammation, and clustering of metabolic risk markers. *Archives of Pediatrics & Adolescent Medicine*, *163*(12), 1135-1143. https://doi.org/10.1001/archpediatrics.2009.214

Davis, E. P., & Narayan, A. J. (2020). Pregnancy as a period of risk, adaptation, and resilience for mothers and infants. *Dev Psychopathol*, *32*(5), 1625-1639. https://doi.org/10.1017/s0954579420001121

De Bellis, M. D., & Zisk, A. (2014). The biological effects of childhood trauma. *Child Adolesc Psychiatr Clin N Am*, *23*(2), 185-222, vii. https://doi.org/10.1016/j.chc.2014.01.002

Deklava, L., Lubina, K., Circenis, K., Sudraba, V., & Millere, I. (2015). Causes of anxiety during pregnancy. *Procedia - Social and Behavioral Sciences*, *205*, 623-626. https://doi.org/https://doi.org/10.1016/j.sbspro.2015.09.097

Dennis, C. L., Falah-Hassani, K., & Shiri, R. (2017). Prevalence of antenatal and postnatal anxiety: systematic review and meta-analysis. *Br J Psychiatry*, *210*(5), 315-323. https://doi.org/10.1192/bjp.bp.116.187179

Dietz, P. M., England, L. J., Shapiro-Mendoza, C. K., Tong, V. T., Farr, S. L., & Callaghan, W. M. (2010). Infant morbidity and mortality attributable to prenatal smoking in the U.S. *Am J Prev Med*, *39*(1), 45-52. https://doi.org/10.1016/j.amepre.2010.03.009

Ding, X. X., Wu, Y. L., Xu, S. J., Zhu, R. P., Jia, X. M., Zhang, S. F., Huang, K., Zhu, P., Hao, J. H., & Tao, F. B. (2014). Maternal anxiety during pregnancy and adverse birth outcomes: a systematic review and meta-analysis of prospective cohort studies. *J Affect Disord*, *159*, 103-110. https://doi.org/10.1016/j.jad.2014.02.027

Doubeni, C. A., Reed, G., & DiFranza, J. R. (2010). Early course of nicotine dependence in adolescent smokers. *Pediatrics*, *125*(6), 1127-1133. https://doi.org/10.1542/peds.2009-0238

Douglas, K. R., Chan, G., Gelernter, J., Arias, A. J., Anton, R. F., Weiss, R. D., Brady, K., Poling, J., Farrer, L., & Kranzler, H. R. (2010). Adverse childhood events as risk factors for substance dependence: partial mediation by mood and anxiety disorders. *Addict Behav*, *35*(1), 7-13. https://doi.org/10.1016/j.addbeh.2009.07.004

Dube, S. R., Anda, R. F., Felitti, V. J., Croft, J. B., Edwards, V. J., & Giles, W. H. (2001). Growing up with parental alcohol abuse: exposure to childhood abuse, neglect, and household dysfunction. *Child Abuse & Neglect*, *25*(12), 1627-1640. https://doi.org/https://doi.org/10.1016/S0145-2134(01)00293-9

Dube, S. R., Felitti, V. J., Dong, M., Giles, W. H., & Anda, R. F. (2003). The impact of adverse childhood experiences on health problems: evidence from four birth cohorts dating back to 1900. *Prev Med*, *37*(3), 268-277. https://doi.org/10.1016/s0091-7435(03)00123-3

Duffy, K. A., McLaughlin, K. A., & Green, P. A. (2018). Early life adversity and health-risk behaviors: proposed psychological and neural mechanisms. *Ann N Y Acad Sci*, *1428*(1), 151-169. https://doi.org/10.1111/nyas.13928

Edwards, V. J., Anda, R. F., Gu, D., Dube, S. R., & Felitti, V. J. (2007). Adverse childhood experiences and smoking persistence in adults with smoking-related symptoms and illness. *Perm J*, *11*(2), 5-13. https://doi.org/10.7812/tpp/06-110

Edwards, V. J., Holden, G. W., Felitti, V. J., & Anda, R. F. (2003). Relationship between multiple forms of childhood maltreatment and adult mental health in community respondents: results from the adverse childhood experiences study. *Am J Psychiatry*, *160*(8), 1453-1460. https://doi.org/10.1176/appi.ajp.160.8.1453

Elliott, J. C., Stohl, M., Wall, M. M., Keyes, K. M., Skodol, A. E., Eaton, N. R., Shmulewitz, D., Goodwin, R. D., Grant, B. F., & Hasin, D. S. (2016). Childhood maltreatment, personality disorders and 3-year persistence of adult alcohol and nicotine dependence in a national sample. *Addiction*, *111*(5), 913-923. https://doi.org/10.1111/add.13292

Elsenbruch, S., Benson, S., Rücke, M., Rose, M., Dudenhausen, J., Pincus-Knackstedt, M. K., Klapp, B. F., & Arck, P. C. (2006). Social support during pregnancy: effects on maternal depressive symptoms, smoking and pregnancy outcome. *Human Reproduction*, *22*(3), 869-877. https://doi.org/10.1093/humrep/del432

Eskritt, M., Doucette, J., & Robitaille, L. (2014). Does future-oriented thinking predict adolescent decision making? *The Journal of Genetic Psychology*, *175*(2), 163-179. https://doi.org/10.1080/00221325.2013.875886

Falah-Hassani, K., Shiri, R., & Dennis, C. L. (2017). The prevalence of antenatal and postnatal co-morbid anxiety and depression: a meta-analysis. *Psychol Med*, *47*(12), 2041-2053. https://doi.org/10.1017/s0033291717000617

Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., Koss, M. P., & Marks, J. S. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *Am J Prev Med*, *14*(4), 245-258. https://doi.org/10.1016/s0749-3797(98)00017-8

Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., Koss, M. P., & Marks, J. S. (2019). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: the Adverse Childhood Experiences (ACE) study. *American Journal of Preventive Medicine*, *56*(6), 774-786. https://doi.org/10.1016/j.amepre.2019.04.001

Fergie, L., Campbell, K. A., Coleman-Haynes, T., Ussher, M., Cooper, S., & Coleman, T. (2019). Stop smoking practitioner consensus on barriers and facilitators to smoking cessation in pregnancy and how to address these: a modified Delphi survey. *Addictive Behaviors Reports*, *9*, 100164. https://doi.org/https://doi.org/10.1016/j.abrep.2019.100164

Figueiredo, B., Field, T., Diego, M., Hernandez-Reif, M., Deeds, O., & Ascencio, A. (2008). Partner relationships during the transition to parenthood. *Journal of Reproductive and Infant Psychology*, *26*(2), 99-107. https://doi.org/10.1080/02646830701873057

Fillo, J., Kamper-DeMarco, K. E., Brown, W. C., Stasiewicz, P. R., & Bradizza, C. M. (2019). Emotion regulation difficulties and social control correlates of smoking among pregnant women trying to quit. *Addict Behav*, *89*, 104-112. https://doi.org/10.1016/j.addbeh.2018.09.033

Finch, J. F., Okun, M. A., Pool, G. J., & Ruehlman, L. S. (1999). A comparison of the influence of conflictual and supportive social interactions on psychological distress. *Journal of Personality*, *67*(4), 581-621. https://doi.org/https://doi.org/10.1111/1467-6494.00066

Flemming, K., McCaughan, D., Angus, K., & Graham, H. (2015). Qualitative systematic review: barriers and facilitators to smoking cessation experienced by women in pregnancy and following childbirth. *J Adv Nurs*, *71*(6), 1210-1226. https://doi.org/10.1111/jan.12580

Ford, E. S., Anda, R. F., Edwards, V. J., Perry, G. S., Zhao, G., Li, C., & Croft, J. B. (2011). Adverse childhood experiences and smoking status in five states. *Preventive Medicine*, *53*(3), 188-193. https://doi.org/https://doi.org/10.1016/j.ypmed.2011.06.015

Forray, A. (2016). Substance use during pregnancy. *F1000Res*, *5*. https://doi.org/10.12688/f1000research.7645.1

Froggatt, S., Covey, J., & Reissland, N. (2020). Infant neurobehavioural consequences of prenatal cigarette exposure: a systematic review and meta-analysis. *Acta Paediatrica*, *109*(6), 1112-1124. https://doi.org/https://doi.org/10.1111/apa.15132

Gage, J. D., Everett, K. D., & Bullock, L. (2007). A review of research literature addressing male partners and smoking during pregnancy. *J Obstet Gynecol Neonatal Nurs*, *36*(6), 574-580. https://doi.org/10.1111/j.1552-6909.2007.00188.x

Gallo, E. A. G., Munhoz, T. N., Loret de Mola, C., & Murray, J. (2018). Gender differences in the effects of childhood maltreatment on adult depression and anxiety: A systematic review and meta-analysis. *Child Abuse Negl.*, *79*, 107-114. https://doi.org/10.1016/j.chiabu.2018.01.003

George, L., Granath, F., Johansson, A. L. V., Annerén, G., & Cnattingius, S. (2006). Environmental tobacco smoke and risk of spontaneous abortion. *Epidemiology*, *17*(5), 500-505. https://doi.org/10.1097/01.ede.0000229984.53726.33

Ghosh, J. K., Wilhelm, M. H., Dunkel-Schetter, C., Lombardi, C. A., & Ritz, B. R. (2010). Paternal support and preterm birth, and the moderation of effects of chronic stress: a study in Los Angeles county mothers. *Arch Womens Ment Health*, *13*(4), 327-338. https://doi.org/10.1007/s00737-009-0135-9

Giedd, J. N., & Rapoport, J. L. (2010). Structural MRI of pediatric brain development: what have we learned and where are we going? *Neuron*, *67*(5), 728-734. https://doi.org/10.1016/j.neuron.2010.08.040

Giesbrecht, G. F., Poole, J. C., Letourneau, N., Campbell, T., Kaplan, B. J., & Team, t. A. S. (2013). The buffering effect of social support on hypothalamic-pituitary-adrenal axis function during pregnancy. *Psychosomatic Medicine*, *75*(9), 856-862. https://doi.org/10.1097/psy.0000000000000004

Gilbert, L. K., Breiding, M. J., Merrick, M. T., Thompson, W. W., Ford, D. C., Dhingra, S. S., & Parks, S. E. (2015). Childhood adversity and adult chronic disease: an update from ten states and the District of Columbia, 2010. *Am J Prev Med*, *48*(3), 345-349. https://doi.org/10.1016/j.amepre.2014.09.006

Gilman, S. E., Breslau, J., Subramanian, S. V., Hitsman, B., & Koenen, K. C. (2008). Social factors, psychopathology, and maternal smoking during pregnancy. *Am J Public Health*, *98*(3), 448-453. https://doi.org/10.2105/ajph.2006.102772

Gilmore, J. H., Knickmeyer, R. C., & Gao, W. (2018). Imaging structural and functional brain development in early childhood. *Nat Rev Neurosci*, *19*(3), 123-137. https://doi.org/10.1038/nrn.2018.1

Gilson, K. J., & Lancaster, S. (2008). Childhood sexual abuse in pregnant and parenting adolescents. *Child Abuse & Neglect*, *32*(9), 869-877. https://doi.org/https://doi.org/10.1016/j.chiabu.2007.11.005

Government of Canada. (2017). *Canadian Tobacco, Alcohol and Drugs (CTADS) Survey: 2017 detailed tables*. https://www.canada.ca/en/health-canada/services/canadian-tobacco-alcohol-drugs-survey/2017-summary/2017-detailed-tables.html

Gratz, K. L., & Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: development, factor structure, and initial validation of the difficulties in emotion regulation scale. *Journal of Psychopathology and Behavioral Assessment*, *26*(1), 41-54. https://doi.org/10.1023/B:JOBA.0000007455.08539.94

Green, J. G., McLaughlin, K. A., Berglund, P. A., Gruber, M. J., Sampson, N. A., Zaslavsky, A. M., & Kessler, R. C. (2010). Childhood adversities and adult psychiatric disorders in the National Comorbidity Survey replication I: associations with first onset of DSM-IV disorders. *Archives of General Psychiatry*, *67*(2), 113-123. https://doi.org/10.1001/archgenpsychiatry.2009.186

Gurung, R. A. R., Dunkel-Schetter, C., Collins, N., Rini, C., & Hobel, C. J. (2005). Psychosocial predictors of prenatal anxiety. *Journal of Social and Clinical Psychology*, *24*(4), 497-519. https://doi.org/10.1521/jscp.2005.24.4.497

Häggström Westberg, K., Wilhsson, M., Svedberg, P., Nygren, J. M., Morgan, A., & Nyholm, M. (2019). Optimism as a candidate health asset: exploring its links with adolescent quality of life in Sweden. *Child Development*, *90*(3), 970-984. https://doi.org/https://doi.org/10.1111/cdev.12958

Halfon, N., & Hochstein, M. (2002). Life course health development: an integrated framework for developing health, policy, and research. *Milbank Q*, *80*(3), 433-479, iii. https://doi.org/10.1111/1468-0009.00019

Hardt, J., & Rutter, M. (2004). Validity of adult retrospective reports of adverse childhood experiences: review of the evidence. *Journal of Child Psychology and Psychiatry*, *45*(2), 260-273. https://doi.org/https://doi.org/10.1111/j.1469-7610.2004.00218.x

Härkönen, J., Lindberg, M., Karlsson, L., Karlsson, H., & Scheinin, N. M. (2018). Education is the strongest socio-economic predictor of smoking in pregnancy. *Addiction*, *113*(6), 1117-1126. https://doi.org/https://doi.org/10.1111/add.14158

Harville, E. W., Boynton-Jarrett, R., Power, C., & Hyppönen, E. (2010). Childhood hardship, maternal smoking, and birth outcomes: a prospective cohort study. *Arch Pediatr Adolesc Med*, *164*(6), 533-539. https://doi.org/10.1001/archpediatrics.2010.61

Hofmann, S. G., Sawyer, A. T., Fang, A., & Asnaani, A. (2012). Emotion dysregulation model of mood and anxiety disorders. *Depression and Anxiety*, *29*(5), 409-416. https://doi.org/https://doi.org/10.1002/da.21888

Hosseinpoor, A. R., Bergen, N., Mendis, S., Harper, S., Verdes, E., Kunst, A., & Chatterji, S. (2012). Socioeconomic inequality in the prevalence of noncommunicable diseases in low- and middle-income countries: results from the World Health Survey. *BMC Public Health*, *12*(1), 474. https://doi.org/10.1186/1471-2458-12-474

Hughes, K., Bellis, M. A., Sethi, D., Andrew, R., Yon, Y., Wood, S., Ford, K., Baban, A., Boderscova, L., Kachaeva, M., Makaruk, K., Markovic, M., Povilaitis, R., Raleva, M., Terzic, N., Veleminsky, M., Włodarczyk, J., & Zakhozha, V. (2019). Adverse childhood experiences, childhood relationships and associated substance use and mental health in young Europeans. *European journal of public health*, *29*(4), 741-747. https://doi.org/10.1093/eurpub/ckz037

Hughes, K. E., Bellis, M. A., Hardcastle, K., Sethi, D., Butchart, A., Mikton, C., Jones, L., & Dunne, M. P. (2017). The effect of multiple adverse childhood experiences on health: a systematic review and meta-analysis. *The Lancet. Public health*, *28*, e356-e366.

IBM Corporation. (2016). SPSS 25.0. In.

Jaccard, J. (2001). *Interaction effects in binary logistic regression* (1st ed.). SAGE Publications, Inc.

Jaffee, S. R., Takizawa, R., & Arseneault, L. (2017). Buffering effects of safe, supportive, and nurturing relationships among women with childhood histories of maltreatment. *Psychological Medicine*, *47*(15), 2628-2639. https://doi.org/10.1017/S0033291717001027

Jesse, D. E., Graham, M., & Swanson, M. (2006). Psychosocial and spiritual factors associated with smoking and substance use during pregnancy in African American and White low-income women. *J Obstet Gynecol Neonatal Nurs*, *35*(1), 68-77. https://doi.org/10.1111/j.1552-6909.2006.00010.x

Jun, H. J., Rich-Edwards, J. W., Boynton-Jarrett, R., Austin, S. B., Frazier, A. L., & Wright, R. J. (2008). Child abuse and smoking among young women: the importance of severity, accumulation, and timing. *J Adolesc Health*, *43*(1), 55-63. https://doi.org/10.1016/j.jadohealth.2007.12.003

Kalmakis, K. A., & Chandler, G. E. (2014). Adverse childhood experiences: towards a clear conceptual meaning. *J Adv Nurs*, *70*(7), 1489-1501. https://doi.org/10.1111/jan.12329

Kalmakis, K. A., & Chandler, G. E. (2015). Health consequences of adverse childhood experiences: a systematic review. *J Am Assoc Nurse Pract*, *27*(8), 457-465. https://doi.org/10.1002/2327-6924.12215

Kassel, J. D., Stroud, L. R., & Paronis, C. A. (2003). Smoking, stress, and negative affect: correlation, causation, and context across stages of smoking. *Psychol Bull*, *129*(2), 270-304. https://doi.org/10.1037/0033-2909.129.2.270

Kathleen Adams, E., Miller, V. P., Ernst, C., Nishimura, B. K., Melvin, C., & Merritt, R. (2002). Neonatal health care costs related to smoking during pregnancy. *Health Economics*, *11*(3), 193-206. https://doi.org/https://doi.org/10.1002/hec.660

Kelly, R. H., Russo, J., & Katon, W. (2001). Somatic complaints among pregnant women cared for in obstetrics: normal pregnancy or depressive and anxiety symptom amplification revisited? *Gen Hosp Psychiatry*, *23*(3), 107-113. https://doi.org/10.1016/s0163-8343(01)00129-3

Kesmodel, U. S. (2018). Cross-sectional studies – what are they good for? *Acta Obstetricia et Gynecologica Scandinavica*, *97*(4), 388-393. https://doi.org/https://doi.org/10.1111/aogs.13331

Kessler, R. C., McLaughlin, K. A., Green, J. G., Gruber, M. J., Sampson, N. A., Zaslavsky, A. M., Aguilar-Gaxiola, S., Alhamzawi, A. O., Alonso, J., Angermeyer, M., Benjet, C., Bromet, E., Chatterji, S., de Girolamo, G., Demyttenaere, K., Fayyad, J., Florescu, S., Gal, G., Gureje, O., . . . Williams, D. R. (2010). Childhood adversities and adult psychopathology in the WHO World Mental Health Surveys. *British Journal of Psychiatry*, *197*(5), 378-385. https://doi.org/10.1192/bjp.bp.110.080499

Kingston, D., Heaman, M., Chalmers, B., Kaczorowski, J., O'Brien, B., Lee, L., Dzakpasu, S., & O'Campo, P. (2011). Comparison of maternity experiences of Canadian-born and recent and non-recent immigrant women: findings from the Canadian Maternity Experiences Survey. *J Obstet Gynaecol Can*, *33*(11), 1105-1115. https://doi.org/10.1016/s1701-2163(16)35078-2

Kivimäki, M., Batty, G. D., Pentti, J., Shipley, M. J., Sipilä, P. N., Nyberg, S. T., Suominen, S. B., Oksanen, T., Stenholm, S., Virtanen, M., Marmot, M. G., Singh-Manoux, A., Brunner, E. J., Lindbohm, J. V., Ferrie, J. E., & Vahtera, J. (2020). Association between socioeconomic status and the development of mental and physical health conditions in adulthood: a multi-cohort study. *The Lancet Public Health*, *5*(3), e140-e149. https://doi.org/10.1016/s2468-2667(19)30248-8

Knekt, P., Heinonen, E., Härkäpää, K., Järvikoski, A., Virtala, E., Rissanen, J., Lindfors, O., & The Helsinki Psychotherapy Study, G. (2015). Randomized trial on the effectiveness of long- and short-term psychotherapy on psychosocial functioning and quality of life during a 5-year follow-up. *Psychiatry Research*, *229*(1), 381-388. https://doi.org/https://doi.org/10.1016/j.psychres.2015.05.113

Korotana, L. M., Dobson, K. S., Pusch, D., & Josephson, T. (2016). A review of primary care interventions to improve health outcomes in adult survivors of adverse childhood experiences. *Clinical Psychology Review*, *46*, 59-90. https://doi.org/https://doi.org/10.1016/j.cpr.2016.04.007

Kreibig, S. D. (2010). Autonomic nervous system activity in emotion: A review. *Biological Psychology*, *84*(3), 394-421. https://doi.org/https://doi.org/10.1016/j.biopsycho.2010.03.010

Kuh, D., Ben-Shlomo, Y., Lynch, J., Hallqvist, J., & Power, C. (2003). Life course epidemiology. *Journal of Epidemiology and Community Health*, *57*(10), 778. https://doi.org/10.1136/jech.57.10.778

Lakey, B. (2013). *Personality and relational processes in perceived support and happiness*.

Lakey, B., Vander Molen, R. J., Fles, E., & Andrews, J. (2016). Ordinary social interaction and the main effect between perceived support and affect. *Journal of Personality*, *84*(5), 671-684. https://doi.org/10.1111/jopy.12190

Lange, S., Probst, C., Rehm, J., & Popova, S. (2018). National, regional, and global prevalence of smoking during pregnancy in the general population: a systematic review and meta-analysis. *The Lancet Global Health*, *6*(7), e769-e776. https://doi.org/https://doi.org/10.1016/S2214-109X(18)30223-7

Larkin, H., Felitti, V. J., & Anda, R. F. (2014). Social work and adverse childhood experiences research: implications for practice and health policy. *Soc Work Public Health*, *29*(1), 1-16. https://doi.org/10.1080/19371918.2011.619433

Lee, L. J., & Lupo, P. J. (2013). Maternal smoking during pregnancy and the risk of congenital heart defects in offspring: a systematic review and metaanalysis. *Pediatr Cardiol*, *34*(2), 398-407. https://doi.org/10.1007/s00246-012-0470-x

Leitch, L. (2017). Action steps using ACEs and trauma-informed care: a resilience model. *Health & Justice*, *5*(1), 5. https://doi.org/10.1186/s40352-017-0050-5

Letourneau, N., Dewey, D., Kaplan, B. J., Ntanda, H., Novick, J., Thomas, J. C., Deane, A. J., Leung, B., Pon, K., & Giesbrecht, G. F. (2019). Intergenerational transmission of adverse childhood experiences via maternal depression and anxiety and moderation by child sex. *Journal of Developmental Origins of Health and Disease*, *10*(1), 88-99. https://doi.org/10.1017/S2040174418000648

Lewis, A. J., Austin, E., & Galbally, M. (2016). Prenatal maternal mental health and fetal growth restriction: a systematic review. *Journal of Developmental Origins of Health and Disease*, *7*(4), 416-428. https://doi.org/10.1017/S2040174416000076

Li, H., Bowen, A., Bowen, R., Balbuena, L., Feng, C., Bally, J., & Muhajarine, N. (2020). Mood instability during pregnancy and postpartum: a systematic review. *Arch Womens Ment Health*, *23*(1), 29-41. https://doi.org/10.1007/s00737-019-00956-6

Li, M., D'Arcy, C., & Meng, X. (2016). Maltreatment in childhood substantially increases the risk of adult depression and anxiety in prospective cohort studies: systematic review, meta-analysis, and proportional attributable fractions. *Psychol Med*, *46*(4), 717-730. https://doi.org/10.1017/s0033291715002743

Lin, W.-H., & Chiao, C. (2021). The relationship between adverse childhood experience and heavy smoking in emerging adulthood: the role of not in education, employment, or training status. *Journal of Adolescent Health*. https://doi.org/https://doi.org/10.1016/j.jadohealth.2021.07.022

Lindert, J., von Ehrenstein, O. S., Grashow, R., Gal, G., Braehler, E., & Weisskopf, M. G. (2014). Sexual and physical abuse in childhood is associated with depression and anxiety over the life course: systematic review and meta-analysis. *International Journal of Public Health*, *59*(2), 359-372. https://doi.org/10.1007/s00038-013-0519-5

Little, J., Cardy, A., & Munger, R. G. (2004). Tobacco smoking and oral clefts: a meta-analysis. *Bull World Health Organ*, *82*(3), 213-218.

Littleton, H. L., Breitkopf, C. R., & Berenson, A. B. (2007). Correlates of anxiety symptoms during pregnancy and association with perinatal outcomes: a meta-analysis. *Am J Obstet Gynecol*, *196*(5), 424-432. https://doi.org/10.1016/j.ajog.2007.03.042

Lobel, M., Cannella, D. L., Graham, J. E., DeVincent, C., Schneider, J., & Meyer, B. A. (2008). Pregnancy-specific stress, prenatal health behaviors, and birth outcomes. *Health Psychology*, *27*(5), 604-615. https://doi.org/10.1037/a0013242

Logan-Greene, P., Green, S., Nurius, P. S., & Longhi, D. (2014). Distinct contributions of adverse childhood experiences and resilience resources: a cohort analysis of adult physical and mental health. *Social Work in Health Care*, *53*(8), 776-797. https://doi.org/10.1080/00981389.2014.944251

Löwe, B., Spitzer, R. L., Williams, J. B. W., Mussell, M., Schellberg, D., & Kroenke, K. (2008). Depression, anxiety and somatization in primary care: syndrome overlap and functional impairment. *General Hospital Psychiatry*, *30*(3), 191-199. https://doi.org/https://doi.org/10.1016/j.genhosppsych.2008.01.001

Madhavanprabhakaran, G. K., D'Souza, M. S., & Nairy, K. S. (2015). Prevalence of pregnancy anxiety and associated factors. *International Journal of Africa Nursing Sciences*, *3*, 1-7. https://doi.org/https://doi.org/10.1016/j.ijans.2015.06.002

Marackova, M., Prasko, J., Matousek, S., Latalova, K., Hruby, R., Holubova, M., Slepecky, M., Vrbova, K., & Grambal, A. (2016). The impact of childhood adversities on anxiety and depressive disorders in adulthood. *Neuro-endocrinology letters*, *37*(7), 478. https://go.exlibris.link/3d7XHb3c

Martikainen, P., Adda, J., Ferrie, J. E., Davey Smith, G., & Marmot, M. (2003). Effects of income and wealth on GHQ depression and poor self rated health in white collar women and men in the Whitehall II study. *Journal of Epidemiology and Community Health*, *57*(9), 718. https://doi.org/10.1136/jech.57.9.718

Martin, L. T., McNamara, M. J., Milot, A. S., Halle, T., & Hair, E. C. (2007). The effects of father involvement during pregnancy on receipt of prenatal care and maternal smoking. *Maternal and Child Health Journal*, *11*(6), 595-602. https://doi.org/10.1007/s10995-007-0209-0

Martinez Leal, I., Taing, M., Correa-Fernández, V., Obasi, E. M., Kyburz, B., Le, K., Koshy, L., Chen, T. A., Williams, T., Casey, K., O'Connor, D. P., & Reitzel, L. R. (2021). Addressing smoking cessation among women in substance use treatment: A qualitative approach to guiding tailored interventions. *International Journal of Environmental Research and Public Health*, *18*(11). https://www.mdpi.com/1660-4601/18/11/5764

Marufu, T. C., Ahankari, A., Coleman, T., & Lewis, S. (2015). Maternal smoking and the risk of still birth: systematic review and meta-analysis. *BMC Public Health*, *15*(1), 239. https://doi.org/10.1186/s12889-015-1552-5

Matthews, K. A., & Gallo, L. C. (2011). Psychological perspectives on pathways linking socioeconomic status and physical health. *Annual Review of Psychology*, *62*(1), 501-530. https://doi.org/10.1146/annurev.psych.031809.130711

McBride, C. M., Baucom, D. H., Peterson, B. L., Pollak, K. I., Palmer, C., Westman, E., & Lyna, P. (2004). Prenatal and postpartum smoking abstinence a partner-assisted approach. *Am J Prev Med*, *27*(3), 232-238. https://doi.org/10.1016/j.amepre.2004.06.005

McDonald, S. W., Lyon, A. W., Benzies, K. M., McNeil, D. A., Lye, S. J., Dolan, S. M., Pennell, C. E., Bocking, A. D., & Tough, S. C. (2013). The All Our Babies pregnancy cohort: design, methods, and participant characteristics. *BMC Pregnancy and Childbirth*, *13*(1), S2. https://doi.org/10.1186/1471-2393-13-S1-S2

McDonald, S. W., Madigan, S., Racine, N., Benzies, K., Tomfohr, L., & Tough, S. (2019). Maternal adverse childhood experiences, mental health, and child behaviour at age 3: the

All Our Families community cohort study. *Prev Med*, *118*, 286-294. https://doi.org/10.1016/j.ypmed.2018.11.013

McDonnell, B. P., & Regan, C. (2019). Smoking in pregnancy: pathophysiology of harm and current evidence for monitoring and cessation. *The obstetrician & gynaecologist*, *21*(3), 169-175. https://doi.org/10.1111/tog.12585

McEwen, B. S., Eiland, L., Hunter, R. G., & Miller, M. M. (2012). Stress and anxiety: structural plasticity and epigenetic regulation as a consequence of stress. *Neuropharmacology*, *62*(1), 3-12. https://doi.org/10.1016/j.neuropharm.2011.07.014

McLaughlin, K. A., Green, J. G., Gruber, M. J., Sampson, N. A., Zaslavsky, A. M., & Kessler, R. C. (2010). Childhood adversities and adult psychiatric disorders in the National Comorbidity Survey Replication II: associations with persistence of DSM-IV Disorders. *Archives of General Psychiatry*, *67*(2), 124-132. https://doi.org/10.1001/archgenpsychiatry.2009.187

Meades, R., & Ayers, S. (2011). Anxiety measures validated in perinatal populations: a systematic review. *Journal of Affective Disorders*, *133*(1), 1-15. https://doi.org/https://doi.org/10.1016/j.jad.2010.10.009

Menke, R. A., Swanson, L., Erickson, N. L., Reglan, G., Thompson, S., Bullard, K. H., Rosenblum, K., Lopez, J. P., Muzik, M., & Michigan, W. G. a. U. o. (2019). Childhood adversity and sleep are associated with symptom severity in perinatal women presenting for psychiatric care. *Archives of Women's Mental Health*, *22*(4), 457-465. https://doi.org/10.1007/s00737-018-0914-2

Mennin, D. S., Heimberg, R. G., Turk, C. L., & Fresco, D. M. (2002). Applying an emotion regulation framework to integrative approaches to generalized anxiety disorder. *Clinical Psychology: Science and Practice*, *9*(1), 85-90. https://doi.org/https://doi.org/10.1093/clipsy.9.1.85

Merrick, M. T., Ford, D. C., Ports, K. A., & Guinn, A. S. (2018). Prevalence of adverse childhood experiences from the 2011-2014 behavioral risk factor surveillance system in 23 states. *JAMA Pediatrics*, *172*(11), 1038-1044. https://doi.org/10.1001/jamapediatrics.2018.2537

Metzler, M., Merrick, M. T., Klevens, J., Ports, K. A., & Ford, D. C. (2017). Adverse childhood experiences and life opportunities: shifting the narrative. *Children and Youth Services Review*, *72*, 141-149. https://doi.org/10.1016/j.childyouth.2016.10.021

Misiak, B., Stańczykiewicz, B., Pawlak, A., Szewczuk-Bogusławska, M., Samochowiec, J., Samochowiec, A., Tyburski, E., & Juster, R.-P. (2022). Adverse childhood experiences and low socioeconomic status with respect to allostatic load in adulthood: A systematic review. *Psychoneuroendocrinology*, *136*, 105602. https://doi.org/https://doi.org/10.1016/j.psyneuen.2021.105602

Molarius, A., Berglund, K., Eriksson, C., Eriksson, H. G., Lindén-Boström, M., Nordström, E., Persson, C., Sahlqvist, L., Starrin, B., & Ydreborg, B. (2009). Mental health symptoms in relation to socio-economic conditions and lifestyle factors – a population-based study in Sweden. *BMC Public Health*, *9*(1), 302. https://doi.org/10.1186/1471-2458-9-302

Morse, C. A., Buist, A., & Durkin, S. (2000). First-time parenthood: influences on pre- and postnatal adjustment in fathers and mothers. *J Psychosom Obstet Gynaecol*, *21*(2), 109-120. https://doi.org/10.3109/01674820009075616

Murphy, A., Steele, M., Dube, S. R., Bate, J., Bonuck, K., Meissner, P., Goldman, H., & Steele, H. (2014). Adverse Childhood Experiences (ACEs) questionnaire and Adult Attachment Interview (AAI): implications for parent child relationships. *Child Abuse Negl*, *38*(2), 224-233. https://doi.org/10.1016/j.chiabu.2013.09.004

Narayan, A. J., Rivera, L. M., Bernstein, R. E., Harris, W. W., & Lieberman, A. F. (2018). Positive childhood experiences predict less psychopathology and stress in pregnant women with childhood adversity: a pilot study of the benevolent childhood experiences (BCEs) scale. *Child Abuse & Neglect*, *78*, 19-30. https://doi.org/https://doi.org/10.1016/j.chiabu.2017.09.022

Nasreen, H. E., Kabir, Z. N., Forsell, Y., & Edhborg, M. (2011). Prevalence and associated factors of depressive and anxiety symptoms during pregnancy: a population based study in rural Bangladesh. *BMC Women's Health*, *11*(1), 22. https://doi.org/10.1186/1472-6874-11-22

Nichols, H. B., & Harlow, B. L. (2004). Childhood abuse and risk of smoking onset. *Journal of Epidemiology and Community Health*, *58*(5), 402-406. https://doi.org/10.1136/jech.2003.008870

Norman, R. E., Byambaa, M., De, R., Butchart, A., Scott, J., & Vos, T. (2012). The long-term health consequences of child physical abuse, emotional abuse, and neglect: a systematic review and meta-analysis. *PLoS Med*, *9*(11), e1001349. https://doi.org/10.1371/journal.pmed.1001349

Olsen, J. M. (2018). Integrative review of pregnancy health risks and outcomes associated with adverse childhood experiences. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, *47*(6), 783-794. https://doi.org/https://doi.org/10.1016/j.jogn.2018.09.005

Oulman, E., Kim, T. H. M., Yunis, K., & Tamim, H. (2015). Prevalence and predictors of unintended pregnancy among women: an analysis of the Canadian Maternity Experiences Survey. *BMC Pregnancy and Childbirth*, *15*(1), 260. https://doi.org/10.1186/s12884-015-0663-4

Perreira, K. M., Marchante, A. N., Schwartz, S. J., Isasi, C. R., Carnethon, M. R., Corliss, H. L., Kaplan, R. C., Santisteban, D. A., Vidot, D. C., Van Horn, L., & Delamater, A. M. (2019). Stress and resilience: key correlates of mental health and substance use in the Hispanic Community Health Study of Latino Youth. *Journal of Immigrant and Minority Health*, *21*(1), 4-13. https://doi.org/10.1007/s10903-018-0724-7

Pilkington, P. D., Milne, L. C., Cairns, K. E., Lewis, J., & Whelan, T. A. (2015). Modifiable partner factors associated with perinatal depression and anxiety: a systematic review and meta-analysis. *Journal of Affective Disorders*, *178*, 165-180. https://doi.org/https://doi.org/10.1016/j.jad.2015.02.023

Poole, J. C., Dobson, K. S., & Pusch, D. (2017). Anxiety among adults with a history of childhood adversity: psychological resilience moderates the indirect effect of emotion dysregulation. *Journal of Affective Disorders*, *217*, 144-152. https://doi.org/https://doi.org/10.1016/j.jad.2017.03.047

Poole, J. C., Dobson, K. S., & Pusch, D. (2018). Do adverse childhood experiences predict adult interpersonal difficulties? The role of emotion dysregulation. *Child Abuse & Neglect*, *80*, 123-133. https://doi.org/10.1016/j.chiabu.2018.03.006

Powers, J. R., McDermott, L. J., Loxton, D. J., & Chojenta, C. L. (2013). A prospective study of prevalence and predictors of concurrent alcohol and tobacco use during pregnancy. *Maternal and Child Health Journal*, *17*(1), 76-84. https://doi.org/10.1007/s10995-012-0949-3

Public Health Agency of Canada. (2009). *What mothers say: the Canadian Maternity Experiences Survey*. Ottawa Retrieved from https://www.canada.ca/content/dam/phac-aspc/migration/phac-aspc/rhs-ssg/pdf/survey-eng.pdf

Racine, N., Devereaux, C., Cooke, J., Eirich, R., Zhu, J., & Madigan, S. (2021). Adverse childhood experiences and maternal anxiety and depression: a meta-analysis. *BMC psychiatry*, *21*(1), 28. https://doi.org/10.1186/s12888-020-03017-w

Racine, N., Madigan, S., Plamondon, A., Hetherington, E., McDonald, S., & Tough, S. (2018). Maternal adverse childhood experiences and antepartum risks: the moderating role of social support. *Arch Womens Ment Health*, *21*(6), 663-670. https://doi.org/10.1007/s00737-018-0826-1

Racine, N., Madigan, S., Plamondon, A., McDonald, S., & Tough, S. (2018). Differential associations of adverse childhood experience on maternal health. *Am J Prev Med*, *54*(3), 368-375. https://doi.org/10.1016/j.amepre.2017.10.028

Racine, N., McDonald, S., Chaput, K., Tough, S., & Madigan, S. (2020). Maternal substance use in pregnancy: differential prediction by childhood adversity subtypes. *Preventive Medicine*, *141*, 106303. https://doi.org/https://doi.org/10.1016/j.ypmed.2020.106303

Racine, N., McDonald, S., Chaput, K., Tough, S., & Madigan, S. (2021). Pathways from maternal adverse childhood experiences to substance use in pregnancy: findings from the All Our Families Cohort. *J Womens Health (Larchmt)*. https://doi.org/10.1089/jwh.2020.8632

Racine, N., Plamondon, A., Hentges, R., Tough, S., & Madigan, S. (2019). Dynamic and bidirectional associations between maternal stress, anxiety, and social support: the critical role of partner and family support. *Journal of Affective Disorders*, *252*, 19-24. https://doi.org/https://doi.org/10.1016/j.jad.2019.03.083

Racine, N., Zumwalt, K., McDonald, S., Tough, S., & Madigan, S. (2020). Perinatal depression: the role of maternal adverse childhood experiences and social support. *J Affect Disord*, *263*, 576-581. https://doi.org/10.1016/j.jad.2019.11.030

Riaz, M., Lewis, S., Naughton, F., & Ussher, M. (2018). Predictors of smoking cessation during pregnancy: a systematic review and meta-analysis. *Addiction*, *113*(4), 610-622. https://doi.org/10.1111/add.14135

Rini, C., Schetter, C. D., Hobel, C. J., Glynn, L. M., & Sandman, C. A. (2006). Effective social support: antecedents and consequences of partner support during pregnancy. *Personal Relationships*, *13*(2), 207-229. https://doi.org/https://doi.org/10.1111/j.1475-6811.2006.00114.x

Rosenman, S., & Rodgers, B. (2004). Childhood adversity in an Australian population. *Soc Psychiatry Psychiatr Epidemiol*, *39*(9), 695-702. https://doi.org/10.1007/s00127-004-0802-0

Ross, K. M., Miller, G., Qadir, S., Keenan-Devlin, L., Leigh, A. K. K., & Borders, A. (2017). Close relationship qualities and maternal peripheral inflammation during pregnancy. *Psychoneuroendocrinology*, *77*, 252-260. https://doi.org/10.1016/j.psyneuen.2017.01.003

Ross, L. E., & McLean, L. M. (2006). Anxiety disorders during pregnancy and the postpartum period: a systematic review. *The journal of clinical psychiatry*, *67*(8), 1285. https://go.exlibris.link/5r1YlFqh

Ross, N., Gilbert, R., Torres, S., Dugas, K., Jefferies, P., McDonald, S., Savage, S., & Ungar, M. (2020). Adverse childhood experiences: assessing the impact on physical and psychosocial health in adulthood and the mitigating role of resilience. *Child Abuse & Neglect*, *103*, 104440. https://doi.org/https://doi.org/10.1016/j.chiabu.2020.104440

Roy-Byrne, P., Davidson, K., Kessler, R., Asmundson, G., Goodwin, R., Kubzansky, L., Lydiard, R., Massie, M., Katon, W., Laden, S., & Stein, M. (2008). Anxiety disorders and comorbid medical illness. *General Hospital Psychiatry*, *30*(3), 208-225. https://doi.org/https://doi.org/10.1016/j.genhosppsych.2007.12.006

Roza, S. J., Verburg, B. O., Jaddoe, V. W., Hofman, A., Mackenbach, J. P., Steegers, E. A., Witteman, J. C., Verhulst, F. C., & Tiemeier, H. (2007). Effects of maternal smoking in pregnancy on prenatal brain development. The Generation R Study. *Eur J Neurosci*, *25*(3), 611-617. https://doi.org/10.1111/j.1460-9568.2007.05393.x

Scheffers-van Schayck, T., Tuithof, M., Otten, R., Engels, R., & Kleinjan, M. (2019). Smoking behavior of women before, during, and after pregnancy: indicators of smoking, quitting, and relapse. *European addiction research*, *25*(3), 132. https://doi.org/10.1159/000498988

Schneider, S., Huy, C., Schütz, J., & Diehl, K. (2010). Smoking cessation during pregnancy: a systematic literature review. *Drug Alcohol Rev*, *29*(1), 81-90. https://doi.org/10.1111/j.1465-3362.2009.00098.x

Shahhosseini, Z., Pourasghar, M., Khalilian, A., & Salehi, F. (2015). A review of the effects of anxiety during pregnancy on children's health. *Mater Sociomed*, *27*(3), 200-202. https://doi.org/10.5455/msm.2015.27.200-202

Shin, S. H., Ksinan Jiskrova, G., Kimbrough, T., Dina, K. T., Lee, E. O., & Ayers, C. E. (2021). Maternal adverse childhood experiences and postpartum depressive symptoms in young, low-income women. *Psychiatry Research*, *296*, 113679. https://doi.org/https://doi.org/10.1016/j.psychres.2020.113679

Shonkoff, J. P., & Garner, A. S. (2012). The lifelong effects of early childhood adversity and toxic stress. *Pediatrics*, *129*(1), e232-246. https://doi.org/10.1542/peds.2011-2663

Skouteris, H., Wertheim, E. H., Rallis, S., Milgrom, J., & Paxton, S. J. (2009). Depression and anxiety through pregnancy and the early postpartum: an examination of prospective relationships. *J Affect Disord*, *113*(3), 303-308. https://doi.org/10.1016/j.jad.2008.06.002

Sloan, E., Hall, K., Simpson, A., Youssef, G. J., Moulding, R., Mildred, H., & Staiger, P. K. (2018). An emotion regulation treatment for young people with complex substance use and mental health issues: a case-series analysis. *Cognitive and Behavioral Practice*, *25*(3), 427-441. https://doi.org/https://doi.org/10.1016/j.cbpra.2017.12.006

Smedberg, J., Lupattelli, A., Mårdby, A.-C., & Nordeng, H. (2014). Characteristics of women who continue smoking during pregnancy: a cross-sectional study of pregnant women and new mothers in 15 European countries. *BMC Pregnancy and Childbirth*, *14*(1), 213. https://doi.org/10.1186/1471-2393-14-213

Smith, M. V., Gotman, N., & Yonkers, K. A. (2016). Early childhood adversity and pregnancy outcomes. *Maternal and Child Health Journal*, *20*(4), 790-798. https://doi.org/10.1007/s10995-015-1909-5

Solomon, L., & Quinn, V. (2004). Spontaneous quitting: self-initiated smoking cessation in early pregnancy. *Nicotine Tob Res*, *6 Suppl 2*, S203-216. https://doi.org/10.1080/14622200410001669132

Sperry, D. M., & Widom, C. S. (2013). Child abuse and neglect, social support, and psychopathology in adulthood: a prospective investigation. *Child Abuse Negl*, *37*(6), 415-425. https://doi.org/10.1016/j.chiabu.2013.02.006

Spielberger, C. D. (2010). State-Trait Anxiety Inventory. *The Corsini encyclopedia of psychology*, 1-1.

Stapleton, L. R. T., Schetter, C. D., Westling, E., Rini, C., Glynn, L. M., Hobel, C. J., & Sandman, C. A. (2012). Perceived partner support in pregnancy predicts lower maternal and infant distress. *Journal of Family Psychology*, *26*(3), 453-463. https://doi.org/10.1037/a0028332

Statistics Canada. (2011a). *2011 National Household Survey, Statistics Canada Catalogue no. 99-014-X2011047*. https://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/dt-td/Rp-eng.cfm?LANG=E&APATH=3&DETAIL=0&DIM=0&FL=A&FREE=0&GC=0&GID=

1118296&GK=0&GRP=1&PID=107758&PRID=0&PTYPE=105277&S=0&SHOWALL=0&SUB=0&Temporal=2013&THEME=98&VID=0&VNAMEE=&VNAMEF=

Statistics Canada. (2011b). *2011 National Household Survey: Immigration, place of birth, citizenship, ethnic origin, visible minorities, language and religion*. https://www150.statcan.gc.ca/n1/daily-quotidien/130508/dq130508b-eng.htm

Stephens, K. K., Fresch, R. J., Degrandis, M., & DeFranco, E. (2020). The association of maternal education on prenatal care sufficiency. *Obstetrics & Gynecology*, *135*. https://doi.org/10.1097/01.Aog.0000664392.22912.83

Strine, T. W., Dube, S. R., Edwards, V. J., Witt Prehn, A., Rasmussen, S., Wagenfeld, M., Dhingra, S., & Croft, J. B. (2012). Associations between adverse childhood experiences, psychological distress, and adult alcohol problems. *American Journal of Health Behavior*, *36*(3), 408-423. https://doi.org/10.5993/AJHB.36.3.11

Strine, T. W., Edwards, V. J., Dube, S. R., Wagenfeld, M., Dhingra, S., Prehn, A. W., Rasmussen, S., McKnight-Eily, L., & Croft, J. B. (2012). The mediating sex-specific effect of psychological distress on the relationship between adverse childhood experiences and current smoking among adults. *Substance Abuse Treatment, Prevention, and Policy*, *7*(1), 30. https://doi.org/10.1186/1747-597X-7-30

Stubbs, B., Hoots, V., Clements, A., & Bailey, B. (2019). Psychosocial well-being and efforts to quit smoking in pregnant women of South-Central Appalachia. *Addictive Behaviors Reports*, *9*. https://doi.org/https://doi.org/10.1016/j.abrep.2019.100174

Szklo, M., & Nieto, F. J. (2018). *Epidemiology: beyond the basics* (Fourth ed.). Oxford University Press.

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *Int J Med Educ*, *2*, 53-55. https://doi.org/10.5116/ijme.4dfb.8dfd

Thoits, P. A. (2011). Mechanisms linking social ties and support to physical and mental health. *J Health Soc Behav*, *52*(2), 145-161. https://doi.org/10.1177/0022146510395592

Thomas, N., Komiti, A., & Judd, F. (2014). Pilot early intervention antenatal group program for pregnant women with anxiety and depression. *Archives of Women's Mental Health*, *17*(6), 503-509. https://doi.org/10.1007/s00737-014-0447-2

Thompson, M. W., Nassar, N., Robertson, M., & Shand, A. W. (2011). Pregnant women's knowledge of obesity and ideal weight gain in pregnancy, and health behaviours of pregnant women and their partners. *Aust N Z J Obstet Gynaecol*, *51*(5), 460-463. https://doi.org/10.1111/j.1479-828X.2011.01328.x

Tong, V. T., Farr, S. L., Bombard, J., D'Angelo, D., Ko, J. Y., & England, L. J. (2016). Smoking before and during pregnancy among women reporting depression or anxiety. *Obstet Gynecol*, *128*(3), 562-570. https://doi.org/10.1097/aog.0000000000001595

Tough, S. C., McDonald, S. W., Collisson, B. A., Graham, S. A., Kehler, H., Kingston, D., & Benzies, K. (2017). Cohort profile: the All Our Babies pregnancy cohort (AOB). *Int J Epidemiol*, *46*(5), 1389-1390k. https://doi.org/10.1093/ije/dyw363

Tsvetkova, L. A., Antonova, N. A., Eritsian, K. Y., Mukhamedrakhimov, R. J., Arintsina, I. A., Dmitrieva, V. V., & Odintsova, V. V. (2018). The tobacco smoking of pregnant women: the role of psycho-social factors. *Probl Sotsialnoi Gig Zdravookhranenniiai Istor Med*, *26*(4), 217-220. https://doi.org/10.32687/0869-866x-2018-26-4-217-220

Turner, J. B., & Turner, R. J. (2013). *Social relations, social integration, and social support*.

Ungar, M., & Liebenberg, L. (2011). Assessing Resilience Across Cultures Using Mixed Methods: Construction of the Child and Youth Resilience Measure. *Journal of Mixed Methods Research*, *5*(2), 126-149. https://doi.org/10.1177/1558689811400607

Van den Bergh, B. R., Mulder, E. J., Mennes, M., & Glover, V. (2005). Antenatal maternal anxiety and stress and the neurobehavioural development of the fetus and child: links and possible mechanisms. A review. *Neurosci Biobehav Rev*, *29*(2), 237-258. https://doi.org/10.1016/j.neubiorev.2004.10.007

Van Hulst, A., Séguin, L., Zunzunegui, M. V., Vélez, M. P., & Nikiéma, B. (2011). The influence of poverty and social support on the perceived health of children born to minority migrant mothers. *Ethn Health*, *16*(3), 185-200. https://doi.org/10.1080/13557858.2011.559536

Van Knippenberg, F. C. E., Duivenvoorden, H. J., Bonke, B., & Passchier, J. (1990). Shortening the state-trait anxiety inventory. *Journal of Clinical Epidemiology*, *43*(9), 995-1000. https://doi.org/https://doi.org/10.1016/0895-4356(90)90083-2

Van Minh, H., Ng, N., Juvekar, S., Razzaque, A., Ashraf, A., Hadi, A., Soonthornthada, K., Kanungsukkasem, U., Bich, T. H., & Byass, P. (2008). Self-reported prevalence of

chronic diseases and their relation to selected sociodemographic variables: a study in INDEPTH Asian sites, 2005. *Prev Chronic Dis*, *5*(3), A86.

VanderWeele, T. J. (2019). Principles of confounder selection. *Eur J Epidemiol*, *34*(3), 211-219. https://doi.org/10.1007/s10654-019-00494-6

Vaske, J. J., Beaman, J., & Sponarski, C. C. (2017). Rethinking internal consistency in cronbach's alpha. *Leisure Sciences*, *39*(2), 163-173. https://doi.org/10.1080/01490400.2015.1127189

Verbeek, T., Bockting, C. L. H., Beijers, C., Meijer, J. L., Van Pampus, M. G., & Burger, H. (2019). Low socioeconomic status increases effects of negative life events on antenatal anxiety and depression. *Women and Birth*, *32*(1), e138-e143. https://doi.org/10.1016/j.wombi.2018.05.005

Wang, J., & Geng, L. (2019). Effects of socioeconomic status on physical and psychological health: lifestyle as a mediator. *Int J Environ Res Public Health*, *16*(2). https://doi.org/10.3390/ijerph16020281

Wittchen, H.-U., Kessler, R. C., Beesdo, K., Krause, P., & Hoyer, J. (2002). Generalized anxiety and depression in primary care: prevalence, recognition, and management. *The journal of clinical psychiatry*, *63*(Suppl 8), 7712.

World Health Organization. (2020). *Adverse Childhood Experiences International Questionnaire (ACE-IQ)*. Retrieved July 2, 2021 from https://www.who.int/publications/m/item/adverse-childhood-experiences-international-questionnaire-(ace-iq)

Wray, J. M., Gass, J. C., & Tiffany, S. T. (2013). A systematic review of the relationships between craving and smoking cessation. *Nicotine & Tobacco Research*, *15*(7), 1167-1182. https://doi.org/10.1093/ntr/nts268

Xu, H., Wen, L. M., Rissel, C., & Baur, L. A. (2013). Smoking status and factors associated with smoking of first-time mothers during pregnancy and postpartum: findings from the healthy beginnings trial. *Maternal and Child Health Journal*, *17*(6), 1151-1157. https://doi.org/10.1007/s10995-012-1108-6

Yang, I., Hall, L. A., Ashford, K., Paul, S., Polivka, B., & Ridner, S. L. (2017). Pathways from socioeconomic status to prenatal smoking: a test of the Reserve Capacity Model. *Nurs Res*, *66*(1), 2-11. https://doi.org/10.1097/nnr.0000000000000191

Yim, I. S., Tanner Stapleton, L. R., Guardino, C. M., Hahn-Holbrook, J., & Dunkel Schetter, C. (2015). Biological and psychosocial predictors of postpartum depression: systematic review and call for integration. *Annu Rev Clin Psychol*, *11*, 99-137. https://doi.org/10.1146/annurev-clinpsy-101414-020426

Young-Wolff, K. C., Alabaster, A., McCaw, B., Stoller, N., Watson, C., Sterling, S., Ridout, K. K., & Flanagan, T. (2019). Adverse childhood experiences and mental and behavioral health conditions during pregnancy: the role of resilience. *J Womens Health 28*(4), 452-461. https://doi.org/10.1089/jwh.2018.7108

Yu, C., Wei, Y., Tang, X., Liu, B., Shen, L., Long, C., Lin, T., He, D., Wu, S., & Wei, G. (2019). Maternal smoking during pregnancy and risk of cryptorchidism: a systematic review and meta-analysis. *Eur J Pediatr*, *178*(3), 287-297. https://doi.org/10.1007/s00431-018-3293-9

Zhang, D., Cui, H., Zhang, L., Huang, Y., Zhu, J., & Li, X. (2017). Is maternal smoking during pregnancy associated with an increased risk of congenital heart defects among offspring? A systematic review and meta-analysis of observational studies. *J Matern Fetal Neonatal Med*, *30*(6), 645-657. https://doi.org/10.1080/14767058.2016.1183640

Appendix 1: Adverse Childhood Experiences Questionnaire

1.	Before 18 years of age: Did you live with anyone who was depressed, mentally ill, or suicidal?	Yes, No
2.	Before 18 years of age: Did you live with anyone who was a problem drinker or alcoholic?	Yes, No
3.	Before 18 years of age: Did you live with anyone who used illegal street drugs or who abused prescription medications?	Yes, No
4.	Before 18 years of age: Did you live with anyone who served time or was sentenced to service time in prison, jail, or other correctional facility?	Yes, No
5.	Before 18 years of age: Were your parents separated or divorced?	Yes, No
6.	Before 18 years of age: How often did you parents or adults in your household ever slap, hit, kick, punch or beat each other up?	Never, Once, More than once
7.	Before 18 years of age: How often did a parent or adult in your home ever hit, beat, kick, or physically hurt you in any way? (Please do not include spanking)	Never, Once, More than once
8.	Before 18 years of age: How often did a parent or adult in your home ever swear at you, insult you, or put you down?	Never, Once, More than once
9.	Before 18 years of age: How often did anyone at least 5 years older than you or an adult ever touch you sexually?	Never, Once, More than once
10.	Before 18 years of age: How often did anyone at least 5 years older than you or an adult try to make you touch them sexually?	Never, Once, More than once
11.	Before 18 years of age: How often did anyone at least 5 years older than you or an adult force you to have sex?	Never, Once, More than once

Appendix 2: Spielberger State Anxiety Inventory

Response option for all of the following include:

1: Not at all
2: Somewhat
3: Moderately so
4: Very much so

1. Right now (in this moment)… I feel calm
2. Right now (in this moment)… I feel secure
3. Right now (in this moment)… I am tense
4. Right now (in this moment)… I am regretful
5. Right now (in this moment)… I am at ease
6. Right now (in this moment)… I feel upset
7. Right now (in this moment)… I am presently worried over possible misfortunes
8. Right now (in this moment)… I feel rested
9. Right now (in this moment)… I feel anxious
10. Right now (in this moment)… I feel comfortable
11. Right now (in this moment)… I feel self-confident
12. Right now (in this moment)… I feel nervous
13. Right now (in this moment)… I feel jittery
14. Right now (in this moment)… I feel "high strung"
15. Right now (in this moment)… I feel relaxed
16. Right now (in this moment)… I feel content
17. Right now (in this moment)… I am worried
18. Right now (in this moment)… I feel overexcited and rattled
19. Right now (in this moment)… I feel joyful
20. Right now (in this moment)… I feel pleasant