

Maternal obesity and childhood maltreatment in pregnant Latina adolescents:
Associations with maternal stress, social support, mental health status and infant birth weight

Patricia K. Semeraro

Submitted in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy
under the Executive Committee
of the Graduate School of Arts and Sciences

COLUMBIA UNIVERSITY

2015

© 2015
Patricia K. Semeraro
All rights reserved

Abstract

Maternal obesity and childhood maltreatment in pregnant Latina adolescents:

Associations with maternal stress, social support, mental health status and infant birth weight

Patricia K. Semeraro

Background: The prevalence of obesity is increasing in the US population, especially among pregnant women extending before, during and after pregnancy. This is a cause for concern, as it poses significant health risks for both mother and infant. Given the urgency of this problem, it is important to examine not only the pathways to obesity in this group but the correlated risks. One significant risk factor for obesity in the general population is childhood maltreatment. This early, varied, and often chronic form of maltreatment, has been associated with long-term adverse physiological and psychological health outcomes across the general population, often conferring heightened risk for health disparities or increasing the burden of already existing disparities. Only two studies have examined childhood maltreatment as a risk factor for maternal obesity and none have examined this relationship in an urban sample of young adult Latina nulliparas. This exploratory study examines relationships between and among a history of early maltreatment, maternal obesity, and key psychosocial risk indices in urban, nulliparous minority adolescents to better understand associations with this risk factor in the context of pregnancy. The Life Course Health Development Framework as outlined by Halfon and Hochstein is the theoretical framework guiding this study.

Methods: This descriptive exploratory study performed a retrospective analysis of a subset of interview-collected data from a larger NIH funded prospective cohort study (1R01MH077144-01A2, Monk, PI). Study participants were pregnant, ranging from 14-19 years of age, and

recruited from obstetrical practices affiliated with a large academic medical center in New York City. The sample was primarily Hispanic. An exploratory correlational design employed bivariate as well as multivariate analyses to examine associations among maternal childhood maltreatment (MCM), depression, PTSD, perceived stress, social support and maternal obesity as measured by pre-pregnancy BMI. An association between pre-pregnancy BMI and infant birth weight was also explored.

Results: Forty-three percent of this study sample experienced at least one form of childhood maltreatment with more than half experiencing multiple forms. A similarly high percentage (40 %) of pre-pregnancy overweight and obesity (BMI \geq 25 and BMI \geq 30 respectively) was also evidenced. Of these, eighteen percent were obese. Maternal childhood maltreatment was significantly associated with depression, PTSD, elevated stress levels and low levels of social support. Clinically important finding, though not statistically significant, was the finding that mothers with MCM were more than twice as likely to have a pre-pregnancy BMI \geq 30 than mothers without MCM. Both of these public health concerns confer a heightened risk for additional short and long-term adverse health outcomes for mothers and infants, especially those already compromised by health disparities.

Conclusions & Implications: This study provides further evidence that childhood maltreatment and pre-pregnancy obesity are significant health priorities requiring attention. It has characterized, for the first time, the high occurrence of both of these health issues in young adult Latina nulliparas. The study presents a preliminary risk profile of significant psychosocial indices associated with childhood maltreatment and pre-pregnancy obesity that can serve to inform the development and implementation of systematic prenatal screening programs for populations at psychosocial risk. Finally, the study finding that a history of childhood

maltreatment more than doubled the risk of pre-pregnancy obesity, while not statistically significant, may be clinically meaningful in that it presents the possibility of early childhood trauma conferring pregnancy-related vulnerability for future adverse health outcomes for both the mothers and their offspring in this group. Next steps in this critical but neglected area of research are to focus on larger population-based studies which will further examine the complex nature of the relationship between MCM and pre-pregnancy obesity as well as correlated risk factors.

Table of Contents

List of Tables	iv
List of Figures	vi
Acknowledgements	vii
Dedication	ix
Chapter 1: Introduction	1
Problem Statement and Research Question	9
Purpose	9
Aims and Hypotheses	10
Conceptual Framework	10
Significance / Rationale	13
Chapter 2: Review of the literature	15
Childhood maltreatment and adult obesity	17
Childhood maltreatment and child and adolescent/young adult obesity	20
Maternal childhood maltreatment and pre-pregnancy obesity	25
Maternal childhood maltreatment and infant birth weight	26
Associations between pre-pregnancy obesity, perceived stress, mental health status and social support	28
Chapter 3: Research Design and Methodology	32
Introduction to the design	32
Methods	33
Procedures	33
Biological Measures	35

Prenatal self-report questionnaires	36
Data Analysis	42
Aims and Hypotheses	42
Power/Sample size calculation	44
Protection of Human Subjects	45
Special Considerations	46
Chapter 4: Results	47
Characteristics of study sample	47
Findings related to maternal childhood maltreatment	50
Findings related to maternal obesity	51
Findings related to psychosocial variables	52
Correlations between variables	54
Bivariate analyses for participant differences on missing data	55
Results of statistical analyses related to aims and hypotheses	56
Chapter 5: Discussion	67
Descriptive findings on study variables	67
Associations among MCM, maternal obesity and psychosocial risk factors	74
Risk profile for pre-pregnancy obesity	74
Association between maternal obesity and infant birthweight	77
Strengths of the study	79
Limitations of the study	79
Implications and Conclusion	81
Clinical practice implications	82

Health policy implications	85
Directions for future research	86
Conclusion	86
References	88
Appendices	114
A. Parent study protocol schedule	115
B. Physiological measures and collection procedures	116
C. New Intrauterine Growth Curves Based on United States Data	121
D. Prenatal self-report questionnaires	122

List of Tables

Table 3.1:	The SCL-90-R PTSD subscale items	41
Table 3.2:	Summary of variables analyzed in this study	42
Table 4.1:	Demographic characteristics of the mothers in the sample	49
Table 4.2:	Pregnancy complications and outcomes	50
Table 4.3:	Findings on maternal childhood maltreatment	51
Table 4.4:	Findings related to maternal obesity	52
Table 4.5:	Findings on maternal obesity among maltreated vs. non-maltreated	52
Table 4.6:	Findings on psychosocial measures	53
Table 4.7:	Correlation matrix for study variables	54
Table 4.8:	T-test analyses for participant differences on missing data	55
Table 4.9:	Chi-square analyses for participant differences on missing data	56
Table 4.10:	Bivariate analyses of association between pre-pregnancy BMI and MCM	57
Table 4.11:	Bivariate analyses testing differences in means between mothers with and mothers without MCM on psychosocial variables	58
Table 4.12:	Full logistic regression model: pre-pregnancy BMI ≥ 30	60
Table 4.13:	Backward elimination logistic regression model: pre-pregnancy BMI ≥ 30	62
Table 4.14:	Forward selection logistic regression model: pre-pregnancy BMI ≥ 30	63
Table 4.15:	Logistic model for pre-pregnancy BMI ≥ 30 , Hosmer Lemeshow Goodness-of Fit Test	64

Table 4.16:	Bivariate analysis of pre-pregnancy BMI and infant birth weight	
	> 4000grams	65
Table 4.17:	Bivariate analysis of pre-pregnancy BMI and infant birth weight	
	< 2500grams	66

List of Figures

Figure 1.1:	Life Course Health Development Framework	11
Figure 1.2:	LCHD Framework for dissertation study	13
Figure 2.1:	Literature Review Search Strategy	16
Figure 5.1:	National rates of at least one type of child maltreatment	69
Figure 5.2:	Prevalence rates of multiple forms of childhood maltreatment among the maltreated mothers	70
Figure 5.3:	Rates of psychological maltreatment	71
Figure 5.4:	Percentage of women entering pregnancy overweight or obese	72

Acknowledgments

Successful completion of this doctoral dissertation has not been achieved in isolation. My work would not have been possible without the support and guidance of many individuals.

My deepest gratitude is to my dissertation advisor, Dr. Joan Kearney. She provided the constant support, encouragement and hands-on guidance needed to complete this dissertation process. Her insightful comments and constructive criticisms at different stages of my research helped me to focus my ideas. I am grateful to her for holding me to a high research standard and demanding clarity in my thoughts and writing. She has taught me what it means to be a nurse researcher. I am very thankful to have had Dr. Kearney as my mentor. She is the epitome of what a good mentor should be creating an atmosphere of mutual respect, trust, understanding and empathy while advancing the educational and personal growth of the student.

I would also like to express my sincerest thanks and appreciation to my dissertation committee members. Dr. Catherine Monk provided me with the opportunity to be part of her research team and access to the data used in this dissertation study. Dr. Haomiao Jia offered his professional advice that guided the data analysis for this study. Dr. Mary Byrne was a great source of feedback, helping to enhance my work in a profound way. Dr. Adena Bargad provided thoughtful comments and suggestions which improved my final product. Thank you all for your dedication which helped to ensure my success.

I would also like acknowledge Dr. Nancy Reame. As my faculty adviser at the beginning of my doctoral journey, she served as an amazing role model of a nurse researcher. Early on, she provided me with a roadmap and many of the tools necessary to achieve my goal of becoming a

nurse scientist. I am also grateful to Dr. Patricia Stone for giving me the opportunity to be a member of her research team. It was an invaluable experience and one I will never forget.

I have made many new friends during my doctoral journey at Columbia. Every person has helped to shape my educational journey in some way. I would especially like to thank Nicole Geller, Annie Rohan, Ann-Margaret Navarra, Andy Phillips and all my friends in the Center for Health Policy. Their support and care have helped me stay focused. I greatly value their friendship and appreciate their belief in me.

Most importantly, none of this would be possible without the love and patience of my family. They have been a constant source of support and strength.

Dedication

I dedicate this dissertation to my husband, John and daughters Samantha and Susannah. You provided the encouragement necessary for me to complete this educational journey and sacrificed countless hours of family time along the way. I love you!

Chapter 1

Introduction

The World Health Organization (2006) has designated childhood maltreatment as a serious health problem which calls for preventive efforts and epidemiological monitoring. Consequently, it stands with other grave health conditions and behaviors that have negative lifelong consequences such as HIV/AIDS or smoking (Butchart, Kahane, Phinney, Mian, & Furniss, 2006). An estimated 686,000 children in the United States are victims of childhood maltreatment, which includes physical, psychological and sexual abuse, as well as physical and emotional neglect. Childhood maltreatment or child abuse and neglect is broadly defined by the federal government as:

Any recent act or failure to act on the part of a parent or caretaker which results in death, serious physical or emotional harm, sexual abuse or exploitation; or an act or failure to act which presents an imminent risk of serious harm (U.S. Department of Health and Human Services, 2013).

Children can suffer multiple types simultaneously and/or sequentially. Neglect is the most prevalent form of child maltreatment with 78.3% of child victims experiencing this type. Physical abuse is suffered by 17.8% of victims, sexual abuse by 9.2% of victims, and psychological or emotional abuse by 8.1% of victims (U.S. Department of Health and Human Services, 2013). Childhood maltreatment spans all racial, ethnic, gender and socioeconomic boundaries. In its most recent report, the U.S. Department of Health and Human Services (2013) estimated that 87 percent of the substantiated cases of childhood maltreatment occurred in three racial or ethnic groups: African American (21%), Hispanic (21.8%) and White (44%).

Childhood maltreatment can lead to a wide range of long- term negative sequelae.

The landmark Adverse Childhood Experiences (ACE) Study (Felitti et al., 1998) is one of the largest investigations to link childhood maltreatment with health and well-being later in life. The ACE Study, which began over a decade ago, is a collaboration between the Centers for Disease Control (CDC) and Kaiser Permanente Department of Preventive Medicine in San Diego, California. Using both retrospective and prospective approaches, this investigation assesses the long term impact of abuse and household dysfunction in childhood (ACE) on the following outcomes in adults: disease risk factors and incidence, quality of life, health care utilization and mortality (Felitti et al., 1998)

Using data from more than 17,000 participants, the ACE Study found that adverse experiences during childhood are major risk factors for the leading causes of illness and death in United States. Results from the ACE Study reveal that adverse childhood experiences (ACEs) are both common and inter-related. In addition, there is a cumulative and direct proportional relationship between the number of ACEs (ACE Score) and the risk for numerous health and social problems, such that individuals with multiple exposures to adverse childhood experiences will be at greater risk for poor health than those individuals with fewer exposures (Felitti et al., 1998). These ACEs have been associated with risk factors for common diseases such as smoking, alcohol abuse, illicit drug use and obesity (Anda et al., 2006; Dube, Felitti, Dong, Giles, & Anda, 2003; Dube, Felitti, Dong, Chapman, et al., 2003; Dube et al., 2006; Dube, Anda, Felitti, Edwards, & Croft, 2002; Williamson, Thompson, Anda, Dietz, & Felitti, 2002). Adverse childhood experiences also pose a much higher risk for depressive disorders and anxiety (Anda et al., 1999; Anda, Whitfield, et al., 2002; Chapman et al., 2004; Dong et al., 2004; Felitti et al., 1998). In addition, exposure to adverse childhood experiences also increases the risk for problematic sexual and reproductive health outcomes, including early age at first intercourse,

teen pregnancy, unintended pregnancy, and sexually transmitted infections (Anda, Chapman, et al., 2002; Anda et al., 2006; Felitti et al., 1998; Hillis et al., 2004; Hillis, Anda, Felitti, Nordenberg, & Marchbanks, 2000).

Childhood maltreatment is an ACE that has been strongly implicated in the development of long-term negative health outcomes such as depression, posttraumatic stress disorder, elevated perceived stress and impaired social support (Bell & Belicki, 1998; Brown, Cohen, Johnson, & Smailes, 1999; Elliott, Cunningham, Linder, Colangelo, & Gross, 2005; Gracia & Musitu, 2003; Harkness, Bagby, & Kennedy, 2012; Heim, Newport, Bonsall, Miller, & Nemeroff, 2001; Hyman, Paliwal, & Sinha, 2007; McEwen, 1998; Nanni, Uher, & Danese, 2012; Nooner et al., 2012; Pine, 2003; Schumm, Stines, Hobfoll, & Jackson, 2005; Seng, Low, Sperlich, Ronis, & Liberzon, 2009; Sperry & Widom, 2013; Vranceanu, Hobfoll, & Johnson, 2007; Widom, 1999; Widom, DuMont, & Czaja, 2007). Studies show that adolescents and young adults who have experienced multiple forms of childhood maltreatment (child multi-type maltreatment) had an elevated risk for current major depressive disorder (MDD) as well as an increased risk of lifetime MDD (Brown et al., 1999; Widom et al., 2007). Researchers have suggested that a history of childhood maltreatment may also have an adverse effect on the course of depression as well as an individual's response to treatment (Harkness et al., 2012; Nanni, et al., 2012). A meta-analysis of sixteen epidemiological studies (23, 544 participants) reported that childhood maltreatment was associated with a increased risk of developing recurrent and persistent episodes of depression (OR: 2.27, 95%CI: 1.80-2.87). Furthermore, a meta-analysis of ten clinical trials (3, 098 participants) found that a history of childhood maltreatment was associated with a lack of response to treatment for depression or remission during treatment (OR: 1.43, 95%CI: 1.11-1.83) (Nanni et al., 2012).

Childhood abuse (sexual and physical) or neglect has been associated with an increased risk of posttraumatic stress disorder (PTSD) in adulthood. A review of studies published between 2000 and 2011 on PTSD during adolescence revealed that more than 50% of teenagers who experienced a sexual trauma had PTSD (Nooner et al., 2012). In a large prospective cohort study (n=1,196) using documented cases of abuse and neglect, those who had been abused or neglected in childhood were at greater risk for current PTSD (OR= 1.86, 95%CI=1.3-2.6) as young adults compared to those in the matched non-victimized group. An increased risk for lifetime PTSD (OR: 1.75, 95%CI: 1.3-2.3) was also found among those experiencing childhood abuse and neglect (Widom, 1999). A history of child multi-type maltreatment is also significantly associated with a posttraumatic stress disorder (PTSD) ($\beta = .73$, $p < .01$) (Vranceanu et al., 2007). With respect to young adult pregnant women, Seng, et al. (2009) found that childhood maltreatment conveyed a 12-fold risk (adjusted OR; 11.9, 95%CI: 3.6-339.9) of PTSD in pregnancy in a socio-demographically and racial diverse sample of nulliparas (n=1,581).

Evidence for the link between childhood maltreatment and stress in adulthood has primarily stemmed from neurobiological research. Studies demonstrated that following exposure to laboratory stressors, adult survivors of childhood maltreatment tend to display heightened neuroendocrine stress responses. These findings suggest that extreme stress or trauma early in life, such as childhood maltreatment, creates a biological vulnerability towards subsequent stress (Heim et al., 2001; McEwen, 1998). Additional studies reported that abuse survivors may be more likely to interpret events and interactions as more threatening based on their past experiences (Pine, 2003; Schumm et al., 2005). In a sample of 100 inner city women, Vranceanu et al. (2007) found a significant association with child multi-type maltreatment and stress ($\beta = .69$, $p < .01$). Research that specifically examines the perceived stress of childhood

maltreatment survivors is limited, but provides support for a significant relationship between childhood maltreatment and perceived stress (Bell & Belicki, 1998; Hyman et al., 2007).

Moreover, Schumm et al. (2005) investigated the association between current perceived stress and psychological health of adult survivors of childhood maltreatment. Stress was defined as the degree to which one experiences resource losses in personal (e.g., self-esteem), instrumental (e.g., finances), material (e.g., car), and social domains. They found that severity of childhood sexual abuse, but not physical abuse, predicted heightened subjective stress among women.

Recent research also supports a relationship between childhood maltreatment and social support. Vranceanu et al. (2007) reported a significant negative relationship between childhood maltreatment and perceived social support ($\beta = .69, p < .01$) whereby those women who had experienced child multi-type maltreatment reported decreased levels of social support. In a prospective cohort study following children with documented histories of child abuse and neglect through adulthood, Sperry & Widom (2013) found significantly lower levels of social support ($p < .001$) in maltreated individuals than in matched controls. Additional studies have demonstrated a link between childhood maltreatment and social isolation (Elliott et al., 2005; Gracia & Musitu, 2003). Using data from the National Youth Survey-New York State, Elliott et al. (2005) reported that adolescents who were physically abused by a parent within the past 12 months perceived themselves as more isolated from their friends and from school than those who did not suffer from abuse when controlling for relevant variables ($\beta = 1.952, p < .001$). In addition, they found Hispanics reported themselves as more socially isolated compared to non-Hispanic Whites ($\beta = 1.081, p < .05$). The results from a cross-sectional study involving 670 non-abusive families and 166 abusive families from Spain and Colombia, support these findings.

Relative to the sense of isolation, Gracia & Musitu (2003) found that in both cultures, abusive parents had a lower degree of interaction with their neighborhood and community.

In addition to the findings linking childhood maltreatment to a number of psychosocial difficulties, early maltreatment has also been linked to obesity (Danese & Tan, 2014; Hemmingsson, Johansson, & Reynisdottir, 2014). Just as childhood maltreatment poses a significant threat to psychological health, it poses a similar threat with respect to this growing national public health concern. National data indicate that 34% of American adults are considered obese (BMI ≥ 30) (Flegal, Carroll, Ogden, & Curtin, 2010). Women lead the obesity epidemic with a current prevalence rate of 36% (Flegal et al., 2010). Minority and socioeconomically disadvantaged women are disproportionately represented in this number. Among racial/ethnic groups, African-American women have the highest prevalence of obesity at 47% followed by Hispanic women at 40% and non-Hispanic white women at 31% (Flegal et al., 2010). Education and income also appear to differentially impact risk. For example, women who have less than a high school education or whose income is $\leq 130\%$ of poverty threshold have twice the obesity rates as women of higher socioeconomic status (Singh, Siahpush, Hiatt, & Timsina, 2011).

One period of life in which the negative correlates and sequelae of obesity are of particular significance is during pregnancy, a vulnerable time in terms of nutrition and health for mother and baby. Achieving optimal weight before pregnancy, and gaining appropriate amounts of weight during pregnancy are recommended to ensure the safe delivery of a healthy baby, and for the future health of the child. According to a recent Institute of Medicine (IOM) report, the increasing rate of maternal overweight and obesity before, during and after pregnancy is a serious health problem for both mothers and children (Rasmussen & Yaktine, 2009). Maternal

obesity is accompanied by adverse outcomes for both the mother and her offspring throughout the childbearing cycle. It contributes to prenatal diseases such gestational diabetes and preeclampsia (Gabbe & Graves, 2003; O'Brien, Ray, & Chan, 2003) and operative and premature deliveries (Dietz, Callaghan, Morrow, & Cogswell, 2005; Siega-Riz et al., 2009). Maternal obesity is also associated with a shorter duration of breast-feeding (Amir & Donath, 2007) and postpartum weight retention (Nohr et al., 2008).

The offspring of overweight and obese pregnant women are also at risk for adverse health outcomes. Researchers have suggested that maternal obesity increases the risk of fetal birth defects and fetal injury during delivery (Castro & Avina, 2002; Catalano & Ehrenberg, 2006; Guelinckx, Devlieger, Beckers, & Vansant, 2008; Smith, Hulsey, & Goodnight, 2008; Vasudevan, Renfrew, & McGuire, 2011; Yogev & Catalano, 2009). Pre-pregnancy overweight/obesity and excess weight gain during pregnancy has also been shown to increase the risk for delivery of an infant who is large for gestational age(LGA) or macrosomic (Baeten, Bukusi, & Lambe, 2001; Frederick, Williams, Sales, Martin, & Killien, 2008; Nohr et al., 2008). LGA is defined as an infant birth weight greater than the 90th percentile for age and gender. Using a national reference based on single live births in the United States, infants born at 40 weeks gestation at the 90th percentile had birth weights greater than 4000 grams and those at the 97th percentile greater than 4400 grams (Olsen, Groveman, Lawson, Clark & Zemel, 2010). Macrosomia is defined by the American College of Obstetricians and Gynecologists (ACOG) as an absolute infant birth weight of greater than 4500 grams (ACOG, 2000). In a meta-analysis of twenty-one studies assessing the association of pre-pregnancy BMI and LGA, Yu et al.(2013) found that compared with normal weight mothers, those who were overweight or obese had an increased the risk of having a LGA infant (OR:1.53, 95%CI: 1.44-1.63; and OR: 1.67, 95%CI :

2:08, 95% CI: 1.95-2.23 respectively). Additionally within this study, the same authors conducted a meta-analysis of ten studies examining the association between pre-pregnancy BMI and macrosomia. Results from this meta-analysis revealed that pre-pregnancy overweight or obesity increased the risk of having a macrosomic infant (OR: 1.67, 95%CI: 1.42-1.97 for overweight mothers and OR: 3.23, 95%CI: 2.68-3.49 for obese mothers). Cedergren (2004) and Rosenberg, Garbers, Chavkin & Chiasson (2003) found that morbidly obese pregnant mothers (pre-pregnancy BMI > 40) were at greatest risk with nearly four times the odds of having a macrosomic or LGA infant when compared to normal weight mothers. In addition, maternal pre-pregnancy obesity is associated with increased risk for obesity in the child at 14 months and at two, three and four years of age (Mesman et al., 2009; Whitaker, 2004).

This risk profile for overweight and obese pregnant women is an important public health concern in light of current US statistics for maternal obesity. Among pregnant women, the prevalence of overweight and obesity (pre-pregnancy BMI ≥ 25 and ≥ 30 respectively) has almost doubled in the last 20 years, from 24% in 1983 to 45% in 2007. Fifty percent of pregnant women in the United States now begin their pregnancies as either overweight or obese. (Vesco et al., 2009) These data pose a significant health research problem.

Though this dissertation study will focus on the larger and more urgent public health issue of maternal obesity, it is important to note that maternal underweight also carries with it the potential for adverse perinatal outcomes for both the mother and her offspring. Under-nutrition and imbalanced diet can contribute to low gestational weight gain and higher risk of small for gestational age (SGA) infants (Jeric et al., 2013; Stotland, Cheng, Hopkins, & Caughey, 2006). Low pre-pregnancy BMI ($< 19.8\text{kg/m}^2$) has also been associated with a higher incidence of first trimester miscarriage and an increased risk of maternal fever, medio-lateral episiotomy and arrest

of active labor (Ehrenberg, Dierker, Milluzzi, and Mercer, 2003; Helgstrand & Andersen, 2005; Maconochie, Doyle, Prior, & Simmons, 2007).

Problem Statement and Research Questions

The increasing prevalence of childhood maltreatment as well as the rising rates of pre-pregnancy and pregnancy obesity may negatively impact the immediate and long-term health of mothers and their infants. To date, there is scant research on the associations among childhood maltreatment, maternal obesity, and adverse pre-pregnancy, pregnancy, and infant outcomes. Moreover, no study has examined these relationships in the growing population of pregnant Latina adolescents, a group characterized by numerous health disparities. Since pregnancy provides an opportunity to identify existing health risks in women and to prevent possible future health problems for women and their children, examination of these relationships is warranted. The primary research question asked in this study is: What are the relationships among maternal childhood maltreatment, obesity, depression, PTSD, stress, and social support in pregnant Latina adolescents. The secondary question asked in this study is: Is there a significant association between maternal obesity and infant birth weight, particularly LGA infant status?

Purpose

The purpose of this exploratory study is to examine relationships among a history of maternal childhood maltreatment (MCM), obesity, and key psychosocial risk indices in a sample of young, pregnant Latina women, a group characterized by health disparities. The aims are: 1) To explore associations among the variables of interest: maternal childhood maltreatment (MCM), maternal obesity and psychosocial risk indicators including depression, PTSD, stress and social support; 2) To examine the predictive relationship of maternal childhood maltreatment, stress, psychiatric and social support status to maternal obesity in nulliparous

adolescent mothers; 3) To explore the association between maternal obesity and infant birth weight (IBW).

Aims and Hypotheses

Aim I: to explore associations among the variables of interest: maternal childhood maltreatment (MCM), maternal obesity and psychosocial risk indicators including depression, PTSD, stress and social support.

Hypothesis 1: MCM will be positively associated with maternal obesity defined as pre-pregnancy BMI ≥ 30 , depression, PTSD, and perceived stress and negatively associated with social support status.

Aim II: to examine the predictive relationships among maternal childhood maltreatment (MCM), stress, psychiatric and social support status on maternal obesity in nulliparous adolescent mothers.

Hypothesis 2.: MCM, higher levels of depression and PTSD symptoms, higher perceived stress levels and lower social support levels will independently predict pre-pregnancy BMI ≥ 30 after adjusting for the other covariates (MCM, depression, PTSD, perceived stress and social support status).

Aim 3: To explore the association between maternal obesity and infant birth weight (IBW).

Hypothesis 3: Pre-pregnancy BMI ≥ 30 will be positively associated with IBW greater than the 90th percentile for gestational age and gender ($> 4000\text{g}$).

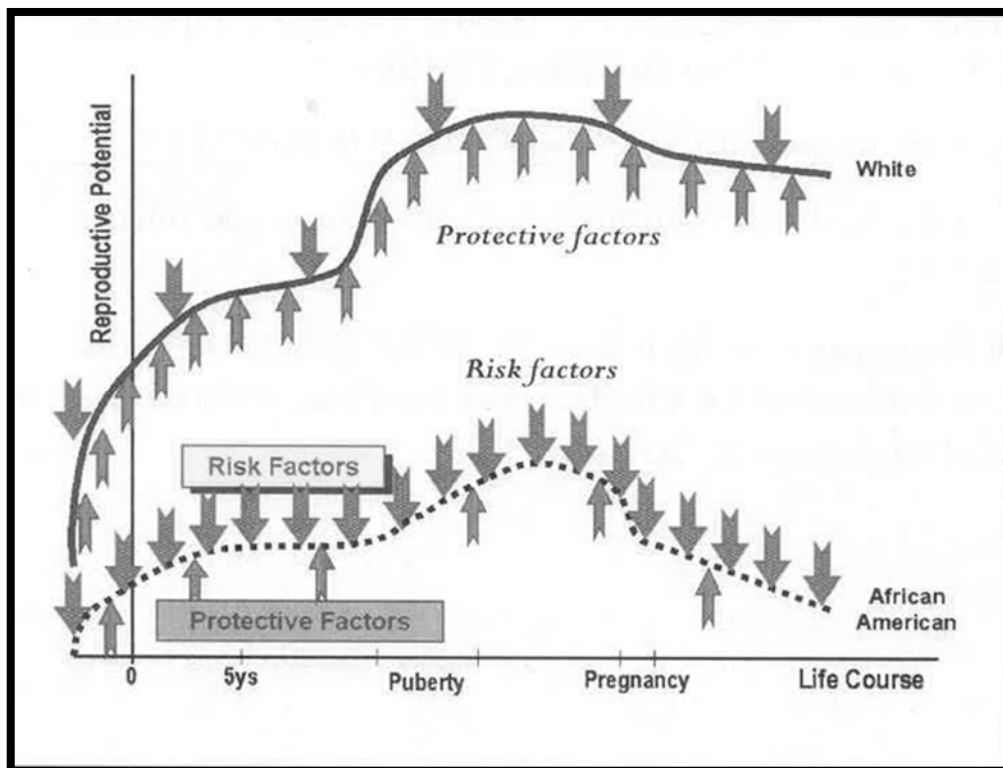
Conceptual Framework

The Life Course Health Development (LCHD) (Halfon & Hochstein, 2002) model provides the conceptual framework for this dissertation study. This framework posits that a complex interplay of biological, behavioral, psychological, and social protective and risk factors

contributes to health outcomes across the span of a person’s life. It integrates a focus on critical periods and early life events with an emphasis on the wear and tear a person experiences over time. The Maternal and Child Health Bureau (MCHB) commissioned a concept paper that provides a succinct summary of the key concepts of the LCHD framework to guide health professionals working with women and children. The key life course concepts include temporal elements including the timing of events over the lifespan, long term health outcomes, environmental forces, protective and risk factors, and health disparities as well as interactive processes and intervention considerations. (Fine & Kotelchuck, 2010) (See Figure 1.1)

Figure 1.1

Life Course Health Development Framework



Source: Lu, M.C. & Halfon, N. (2003) Racial and ethnic disparities in outcomes: a life course perspective. *Maternal Child Health Journal*, 7:13-30.

This dissertation study is concerned primarily with environmental and physical risk factors occurring along the maternal life course that have long term temporal health effects including negative maternal psychosocial and infant outcomes. These are studied within a critical period- pregnancy- and are examined within a group of young urban women characterized by health disparities. Figure 1.2 highlights the components of the LCHD theoretical framework that are the focus of this dissertation study.

Guided by the LCHD framework, this dissertation study postulates that there is an association among maternal childhood maltreatment and both physical and psychosocial risk factors that may result in adverse health outcomes for both the mother and infant.

Figure 1.2

LCHD Framework for primary aim of dissertation study

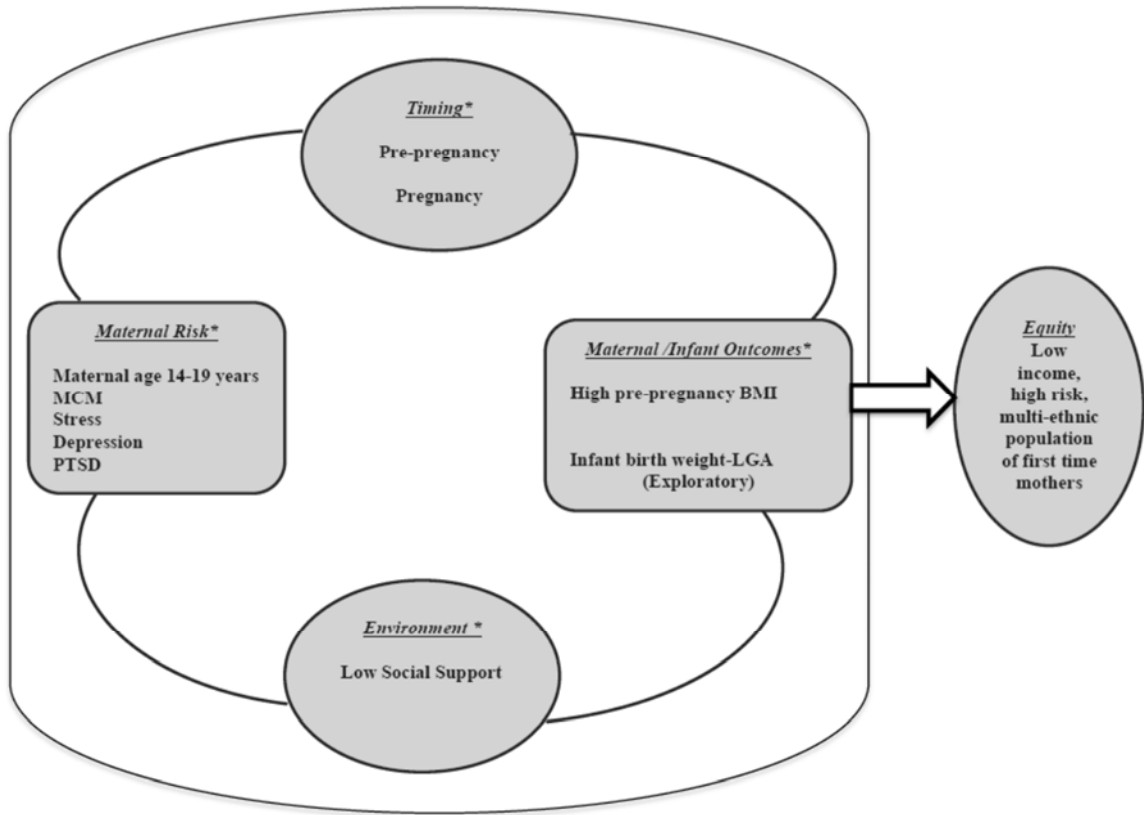


Figure taken from Kearney & Byrne, 2013

Source: Original terms based on text in: Fine, A. & Kotelchuck, M. Rethinking MCH: The Life Course Model as an Organizing Framework. DHHS HRSA, MCHB. November 2010. Available at: mchb.hrsa.gov/lifecourse/rethinkingmchlifecourse.pdf

Significance / Rationale

Childhood maltreatment has a negative long-term and cumulative impact on the physical and psychological health of children, adolescents and adults including depression and other psychiatric conditions as well as physical illness and obesity. The Healthy People 2020 initiative

has identified childhood maltreatment and a healthy pre-pregnancy weight as two separate nationwide health priorities that need our attention in order to improve the health and well-being of mothers, infants and children in the United States. (U.S. Department of Health and Human Services, 2010). Specifically, a reduction in childhood maltreatment cases and an increase in the proportion of mothers delivering a live birth who had a healthy weight (BMI: 18.5-24.9) prior to pregnancy are two important objectives to strive for by the year 2020. In addition, in January 2015, the National Institute of Nursing Research (NINR) posted a call for nursing research aimed at improving outcomes for women, infants and children through interdisciplinary research focused on maternal nutrition, and pre-pregnancy obesity (PA-15-100). Examining these two health priorities, as related entities instead of two distinct and separate ones, can maximize our efforts to achieve these health goals. Health care providers, educators, social service organizations and policy makers have only recently begun examining chronic health conditions through the lens of the life course health development framework. The linkages between the original traumatic insults and current health problems are often hidden-blurred by the passage of time (Lanius, Vermetten, & Pain, 2010). Therefore, the exploration of childhood maltreatment and associated risk indices for less than optimal maternal pre-pregnancy weight is an important step toward refocusing our approach to the prevention and remediation of a significant national health risk.

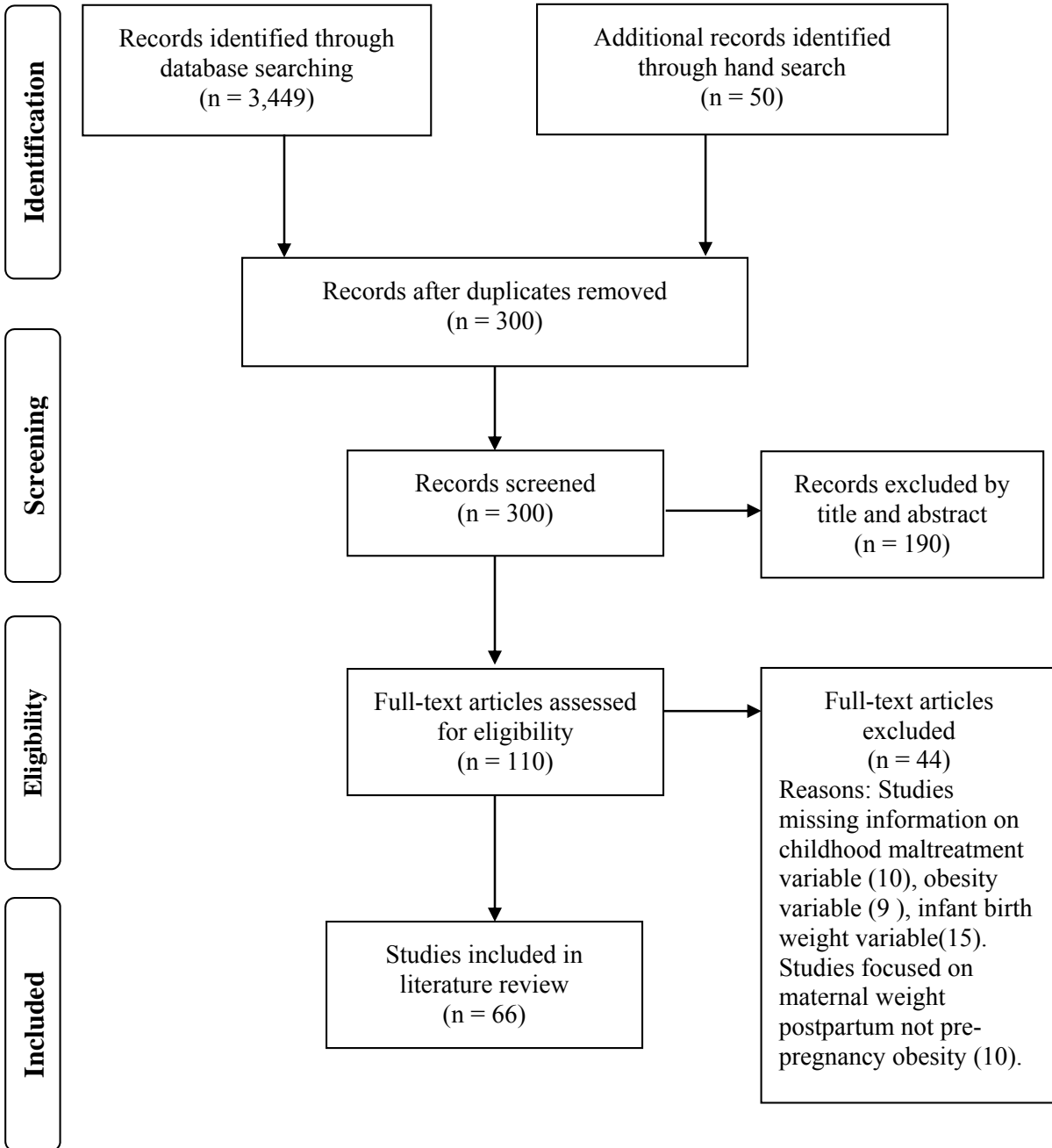
Chapter 2

Review of the literature

This comprehensive literature review is organized around the key constructs and variables examined in this study along with their correlates. A general review of the findings regarding maltreatment and obesity is provided along with those specific to the associations between pre-pregnancy BMI, newborn weight and maternal history of early maltreatment. A comprehensive search strategy was conducted in four electronic databases: PubMed, PsycINFO, Scopus, and Google Scholar. Primary research articles with a focus on childhood maltreatment and its general effects on weight as well as pre-pregnancy BMI and infant birth weight were included. Commentaries, editorials, opinion pieces, and policy documents were excluded. Hand-search was employed and the snowballing technique used to locate additional relevant articles from the reference lists of those articles already identified. Stem search terms included childhood maltreatment, weight, pre-pregnancy BMI and infant birth weight. All terms were joined by Boolean operators as (1) child* maltreatment, child*abuse, child* neglect, family conflict, early experience; (2) weight, obesity, overweight, body mass index, pre-pregnancy BMI, adiposity, infant birth weight, pregnancy weight gain; (3) infant, child, adolescent, young adult, adult, (4) stress, perceived stress, psychosocial support, depression and Posttraumatic Stress Disorder; and searched as subject heading or keywords. Search areas included topic, title, and abstract with language restricted to English. This comprehensive search strategy yielded a total of 3,499 articles. One hundred and ten full text articles were assessed for eligibility. Sixty-four articles determined to be relevant to the key constructs and variables of the study were included in the literature review. See Figure 2.1 for flow chart.

Figure 2.1

Literature Review Search Strategy (PRISMA format)



Source: Moher D, Liberati, A., Tetzlaff J., & Altman, D.G. The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med* 6(6): e1000097. doi:10.1371/journal.pmed1000097

Childhood maltreatment and adult obesity

A robust body of literature provides support for an association between childhood maltreatment and adverse adult health outcomes (Lanius et al., 2010). In particular, a growing body of evidence suggests that childhood maltreatment is associated with adult obesity. Twenty-four (83%) studies reported a positive association between at least one type of childhood maltreatment and adult obesity in contrast to five (17%) that reported non-significant relationships (Hepgul et al., 2012; Lehman, Taylor, Kiefe, & Seeman, 2005; Min, Minnes, Kim, & Singer, 2013; Pederson & Wilson, 2009; Rodgers et al., 2004).

Ten of these studies examined the relationship between all forms of childhood maltreatment and adult obesity. Five predicted a positive association across all abuse subtypes (D'Argenio et al., 2009; Dube, Cook, & Edwards, 2010; Felitti, 1993; Greenfield & Marks, 2009; Midei, Matthews, & Bromberger, 2010). Two studies found all forms of childhood maltreatment, except for childhood sexual abuse and childhood emotional neglect (Thomas, Hypponen, & Power, 2008; van Reedt Dortland, Giltay, van Veen, Zitman, & Penninx, 2012) to be associated with an increased risk for both total and central obesity in adulthood. Three reported significant positive relationships with just one form of childhood maltreatment including: childhood physical abuse (Bentley & Widom, 2009), childhood sexual abuse (Walker, Gelfand, et al., 1999) and childhood emotional abuse (Gunstad et al., 2006). In contrast to the overwhelming majority of findings, Gunstad et al. (2006) reported this relationship in men only with no association between any type of childhood maltreatment and obesity in women. This finding was unexpected and inconsistent with previous research, and may be related to methodological issues. Specifically, this study employed strict sampling criteria including only a non-clinical sample of men and women with a positive history of early life trauma. As far as differences

related to gender, the authors suggest that meditational relationships may account for this finding, but that has yet to be determined.

Five studies focused exclusively on the relationship between childhood sexual abuse and adult obesity (Aaron & Hughes, 2007; Brown, Garrison, Anderson, & Saunders, 1990; Coker et al., 2008; Felitti, 1991; Smith et al., 2010; Springs & Friedrich, 1992). Four of these study samples were female and the fifth sample incorporated only a small percentage (4%) of men (Felitti, 1991). In addition, Aaron & Hughes, (2007) confined their sample to a community group of self-identified lesbians while Smith et al., (2010) compared samples of both heterosexual and lesbian women. Both of these studies revealed that lesbian women who had reported childhood sexual abuse were at greater risk for obesity, however, Smith et al. (2010) suggested that intra-familial childhood sexual abuse may play a role in the development of obesity in adulthood regardless of sexual orientation.

Other studies examined childhood physical abuse together with sexual abuse and their association with adult obesity (Alvarez, Pavao, Baumrind, & Kimerling, 2007; Boynton-Jarrett, Rosenberg, Palmer, Boggs, & Wise, 2012; Chartier, Walker, & Naimark, 2009; Felitti, 1993; Jia, Li, Leserman, Hu, & Drossman, 2004; Rich-Edwards et al., 2010; Rohde et al., 2008). All of the studies reported a significant positive association between adult obesity and both childhood physical and sexual abuse, with the exception of the study by Chartier et al. (2009) which found a significant prediction for obesity with respect to childhood sexual abuse only (aOR: 1.61; 95% CI: 1.14-2.27; $p \leq 0.05$). Chartier's findings are discrepant with the general literature, however, and should be tested further. In keeping with the majority of findings, two studies (Moeller, Bachmann, & Moeller, 1993; Williamson et al., 2002) included childhood emotional abuse as a

study variable along with childhood physical and sexual abuse and both reported significant positive associations with adult obesity in all three subtypes.

Despite somewhat conflicting results, these studies lend general support to the association between various forms of childhood maltreatment and adult obesity. An important methodological strength of these studies is that all but one contained a control group with no abuse history (Coker et al., 2008). Several limitations exist as well, centering on design, sampling and measurement.

Only five studies used a prospective cohort design (Bentley & Widom, 2009; Midei et al., 2010; Min et al., 2013; Rich-Edwards et al., 2010; Thomas et al., 2008). The remaining studies included cross-sectional and case-control designs. In addition, more than half of the studies included only female participants (Aaron & Hughes, 2007; Alvarez et al., 2007; Boynton-Jarrett et al., 2012; Coker et al., 2008; Jia et al., 2004; Midei et al., 2010; Min et al., 2013; Moeller et al., 1993; Pederson & Wilson, 2009; Rich-Edwards et al., 2010; Rodgers et al., 2004; Rohde et al., 2008; Smith et al., 2010; Springs & Friedrich, 1992; Walker, Gelfand, et al., 1999). With the exception of two studies that examined largely African American samples (Boynton-Jarrett et al., 2012; Rodgers et al., 2004), the remainder were conducted with primarily White populations.

There was wide variability in the measurement of childhood maltreatment, ranging from a single item measurement approach (Aaron & Hughes, 2007; Alvarez et al., 2007; Rohde et al., 2008) to the use of court-substantiated cases of abuse as an indication of childhood maltreatment (Bentley & Widom, 2009). Only half of the studies used validated instruments to measure this construct (Alvarez et al., 2007; Boynton-Jarrett et al., 2012; Chartier et al., 2009; D'Argenio et al., 2009; Greenfield & Marks, 2009; Gunstad et al., 2006; Midei et al., 2010; Rich-Edwards et al., 2010; Rohde et al., 2008; van Reedt Dortland et al., 2012; Walker, Gelfand, et al., 1999;

Williamson et al., 2002). This presents a methodological concern in that validity of findings may be impacted. With respect to measurement of obesity, the majority of studies employ a definition based on body mass index (BMI). More than half of these studies used self-reported height and weight versus lab-measured indices. The use of these self-reported measures may present a self-report bias characterized by general overestimation of height and underestimation of weight (Krul, Daanen, & Choi, 2011).

Childhood maltreatment and child and adolescent/young adult obesity

While numerous studies have linked childhood maltreatment with adult obesity, the association between childhood maltreatment and obesity in children and adolescents and young adults has received less attention. A total of twenty studies examined this relationship. Several studies explored the relationship between all abuse subtypes and obesity in child, adolescent and young adult populations (Burke, Hellman, Scott, Weems, & Carrion, 2011; Fuemmeler, Dedert, McClernon, & Beckham, 2009; Hussey, Chang, & Kotch, 2006; Schneiderman, Mennen, Negriff, & Trickett, 2012). Burke et al. (2011) reported that endorsement of four or more adverse childhood experience (ACE) categories increased the odds for the development of obesity twofold (OR: 1.99; 95% CI: 1.11-3.55; $p = 0.02$). The ACE categories have been defined in the landmark Adverse Childhood Experiences (ACE) study, a continuing research collaboration between the Centers for Disease Control and Prevention (CDC) and Kaiser Permanente. The study identified ten categories of adverse childhood experiences. They include the following: physical abuse, verbal abuse, sexual abuse, physical neglect, and emotional neglect as well as a parent who's an alcoholic, a mother who's a victim of domestic violence, a family member in jail, a family member diagnosed with a mental illness, and the disappearance of a parent through divorce, death or abandonment (Felitti & Anda, 2010). With respect to the relationship of these

experiences to young adult obesity, there are only a two studies that have been conducted and neither has used the ACE framework to define adverse childhood experiences. In these two studies, Fuemmeler et al. (2009) found that endorsement of childhood sexual abuse alone was positively associated with an increased risk for obesity in young adult males only while Hussey et al. (2006) reported that endorsement of childhood physical abuse alone increased the likelihood of developing adult obesity (aOR: 1.20, $p \leq 0.05$).

Several studies focused exclusively on one type of childhood maltreatment and its relationship to obesity in children and adolescents/young adults. For example, three studies examined only childhood sexual abuse (Mamun et al., 2007; Noll, Zeller, Trickett, & Putnam, 2007; Pinhas-Hamiel, Modan-Moses, Herman-Raz, & Reichman, 2009). Pinhas-Hamiel et al. (2009) specifically assessed the relationship between penetrative sexual abuse in childhood and childhood obesity among a group of girls (ages 11-15) referred to a hospital based obesity program. Five of the 145 girls recruited for the study reported penetrative sexual abuse. The girls who were abused were significantly more obese than the remainder of the patients (4.76 ± 1.34 vs. 3.39 ± 1.28 , $p = 0.02$). While four of the five abused girls were reportedly overweight prior to the assault, a marked weight gain was subsequently documented. Mamun et al. (2007) and Noll et al. (2007) reported a similar finding, but in young adults (ages 21-24 years). They concluded that the odds of obesity in young adulthood were increased 2–3 times among those young women who experienced penetrative sexual abuse in childhood.

While child neglect is the most common form of childhood maltreatment, it has received far less attention from professionals and researchers compared to physical and sexual abuse (U.S. Department of Health and Human Services, 2013). Five studies reported significant associations between child neglect and obesity in children and the adolescent and young adult population.

Two studies examined this relationship in young children (ages 3-9 years). Knutson, Taber, Murray, Valles, and Koepl (2010) found that care neglect significantly correlated with obesity for younger (ages 3-6 years) but not older children (6-9 years.) In contrast, supervisory neglect significantly correlated with obesity for older but not younger children. Care neglect was conceptualized in this study as poor hygiene, exposure to household environmental hazards, and inadequate health care. Supervisory neglect was conceptualized as parental lack of awareness of child activities, personal preferences, and the child's engagement in risky or deviant behaviors (Knutson, DeGarmo, Koepl, & Reid, 2005; Knutson, DeGarmo, & Reid, 2004). In another study of over 2400 urban 3-year-old children, Whitaker, Phillips, Orzol, and Burdette (2007) found that the odds of obesity were 50% higher in those exposed to neglect in the prior year compared to those children who never experienced neglect. This finding persisted after controlling for maternal obesity and multiple socio-demographic covariates. No association was found with other forms of child maltreatment.

Three prospective cohort studies examined the association of childhood neglect and obesity in adolescents and young adults (14-22 years). In a sample of 756 Danish school children, Lissau and Sorensen (1994) found the odds of obesity in adolescence and young adulthood were increased 7–10 times among those who were “neglected” as children. Children were considered neglected on the basis of being rated by their teacher as having “no parental support” or by the school medical service (mainly school nurses) as having hygiene that was “dirty and neglected”. Johnson, Cohen, Kasen, and Brook (2002) in a community-based sample of 782 reported that the odds of obesity in adolescence and young adulthood were increased nearly 5 times among those who were “physically neglected” as children. (AOR: 4.66; 95%CI: 1.65-13.16, $p = 0.01$). Children were considered neglected on the basis of a substantiated report

by Child Protective Services. Using a subsample of data drawn from the National Longitudinal Study of Adolescent Health (AddHealth), Shin and Miller (2012) reported that the co-occurrence of childhood neglect and childhood physical abuse was significantly related to increased levels of BMI at baseline. This relationship was not significant for childhood neglect alone. However, those individuals with a history of childhood neglect had a faster rate of BMI growth over time compared to children who experienced no maltreatment. In this study, children were considered neglected if they responded affirmatively to a single question in a computer-assisted interview.

One study has linked childhood maltreatment with both underweight status and overweight or obese status (Roeholt, Beck, Karsberg, & Elklit, 2012). In a nationally representative sample of 2,981 Danish young adults (24 years old), Roeholt et al. (2012) found that childhood maltreatment was significantly associated with both underweight and overweight/obesity. In particular, childhood emotional abuse was associated with underweight, whereas childhood sexual and overall abuse were associated with overweight/obesity.

In contrast to the previous studies, Schneiderman et al. (2012) noted a significant negative relationship between childhood maltreatment and obesity in young adults. In a sample of 303 children (ages 9-12), they found that all forms of child maltreatment reduced the odds of having a high BMI. The remaining studies reported non-significant findings (Bennett, Sullivan, Thompson, & Lewis, 2010; Clark, Thatcher, & Martin, 2010; Holmberg & Hellberg, 2010; Moyer, DiPietro, Berkowitz, & Stunkard, 1997; Sickel, Noll, Moore, Putnam, & Trickett, 2002).

The lack of consensus evident in these studies demonstrates the need for continued research on the impact of child maltreatment on the health of children and adolescents. These inconsistencies may be due in part to several methodological issues including reporting bias, study design, and measurement. In four of the studies, the history of childhood maltreatment was

obtained from an individual other than the child or adolescent, such as a parent, teacher or healthcare provider (Burke et al., 2011; Danese et al., 2011; Knutson et al., 2010; Lissau & Sorensen, 1994; Whitaker et al., 2007). For example, while young children may not be able to understand or articulate reliable information regarding abuse, parents, particularly abusive parents, may not or may be highly unlikely to report abuse to a primary care provider who is a mandated reporter, thereby resulting in an underreporting of abuse exposure. Another methodological issue is that majority of studies were cross-sectional. This limits the ability to infer causation with regard to the associations between childhood maltreatment and obesity in this pediatric population. In addition, less than half of the studies had control groups. Without a control group, there is no basis for knowing if the development of obesity is due to the history of childhood maltreatment or to some other factors. Several measurement issues may also have contributed to the inconsistencies in the study findings. Various methods were used to ascertain the presence or absence of childhood maltreatment. These ranged from self-report questionnaires and retrospective record reviews to Child Protective Services (CPS) confirmed cases of abuse. For those studies that employed self-report questionnaires to measure childhood maltreatment, only three studies used validated instruments (Burke et al., 2011; Clark et al., 2010; Knutson et al., 2010; Whitaker et al., 2007).

Though these studies have limitations, there are also important strengths. In sixty percent of the studies, trained individuals in a laboratory setting measured obesity as an outcome variable. With the exception of one study, obesity was defined as BMI calculated from lab measured height and weight. (Danese et al., 2011) Additionally, a significant contribution of many of these studies is that they have broadened the research focus of childhood maltreatment to include its most common form, childhood neglect.

Maternal childhood maltreatment and pre-pregnancy obesity

The childbearing period is a critical time when many women become overweight/obese or their level of overweight increases substantially. According to an Institute of Medicine (IOM) report, the increasing rate of maternal overweight and obesity before pregnancy is a serious health problem for both mothers and children (Rasmussen & Yaktine, 2009). Pregnancy can be particularly challenging for mothers with a history of childhood maltreatment. During pregnancy, women's bodies undergo many physical changes. After delivery, a woman's role may also change with the arrival of the completely dependent infant. Daily stressors may increase with the demands on time and resources that come with caring for an additional family member. These changes may be particularly difficult for the trauma survivor.

Hollingsworth, Callaway, Duhig, Matheson, and Scott (2012) explored the relationship between maltreatment in childhood and pre-pregnancy obesity. In a sample of two hundred thirty-nine Australian mothers attending antenatal care clinics, the authors found that pre-pregnancy obesity was associated with a self-reported history of childhood emotional and physical maltreatment. The well-validated Childhood Trauma Questionnaire (CTQ) measured childhood maltreatment, and a dose dependent response was found. For example, mothers who reported moderate to severe levels of maltreatment had increased odds of being obese prior to pregnancy. Specifically, mothers exposed to moderate to severe levels of emotional maltreatment were almost two and half times more likely to be obese prior to pregnancy (OR: 2.40; 95% CI: 1.19 - 4.84; $p < .05$) compared to mothers experiencing none to minimal maltreatment. Mothers reporting exposure to moderate to severe levels of physical maltreatment had similar odds (OR: 2.39; 95% CI: 1.18 - 4.79; $p < .05$). There was no significant relationship found between pre-pregnancy obesity and other forms of maltreatment. Diesel, Bodnar, Day & Larkby (2014) also

examined the relationship between childhood maltreatment and pre-pregnancy obesity. In this retrospective analysis of data (n=472) from the Maternal Health Practices and Development (MHPCD) cohort study, the authors concluded that a history of childhood maltreatment was associated with an increased risk of pre-pregnancy obesity among women with elevated anxiety compared with those with lesser levels (Relative risk (RR): 1.45, 95%CI: 1.12—1.88; RR:1.10, 95%CI: 0.81-1.51). These two studies, although retrospective in design, are in keeping with the findings that early childhood physical and emotional maltreatment are associated with later obesity. However, additional research is needed to explore this relationship further.

Maternal childhood maltreatment and infant birth weight

Despite the dearth of studies examining maternal childhood maltreatment and pre-pregnancy weight outcomes, a small body of research has explored the relationship between maternal abuse in childhood and infant birth weight. In two of these studies, maternal childhood maltreatment was an independent predictor of infant birth weight. One was a recent large population-based study conducted by Cederbaum, Putnam-Hornstein, King, Gilbert, and Needell (2013). This study matched data from California vital statistic birth record files to child protective service substantiated reports of childhood maltreatment. The authors found that the maltreatment history of adolescent mothers was associated with a small, but significant increase in low birth weight after controlling for known factors predictive of negative birth outcomes (aRR= 1.06, 95% CI: 1.01-1.12, $p < 0.05$). In a 3-year prospective cohort study, Stevens-Simon and McAnarney (1994) examined the relationship between a history of maltreatment and infant birth weight in a single sample of 127 black adolescents enrolled in the Rochester Study of Adolescent Pregnancy. The study concluded that victims of childhood physical and sexual abuse gave birth to significantly smaller infants compared to their non-abused peers ($2,904 \pm 676$ vs.

3,198 ± 443 grams, $p < 0.01$). In addition, 21.4% of abused adolescents delivered a low birth weight infant weighing less than 2500 grams compared to 4.7% of non-abused adolescents.

The three other studies evaluated whether maternal childhood maltreatment was linked to the birth weight of later born offspring. These studies did not find a direct association, but instead discovered that maternal childhood maltreatment predicted infant birth weight through several mediated pathways including substance abuse and psychiatric symptom clusters. Gavin, Hill, Hawkins, and Maas (2011) examined data from two longitudinal studies- the Seattle Social Development Project (SSDP) and the Intergenerational Project (TIP). The sample included 136 mothers and their eldest biological child in which substance abuse was found to mediate the relationship between MCM and offspring birth weight. In a second study, Gavin, Thompson, Rue, and Guo (2012) examined the same variables childhood maltreatment and offspring birth weight using a subset of data drawn from the National Longitudinal Study of Adolescent Health (Add Health). AddHealth is an ongoing longitudinal study of a nationally representative sample of adolescents in grades 7-12 in the United States that began during the 1994 and followed the respondents into young adulthood utilizing home interviews. This infant birth weight study included a subsample of 1,897 nulliparous females who gave birth to a live singleton infant between 1996 -2002. Findings from this second study supported those from the earlier one in that maternal adolescent substance abuse, including prenatal cigarette use partially mediated the association between maternal childhood maltreatment and lower offspring birth weight. In addition, maternal adolescent depressive symptoms partially mediated this. Seng, Low, Sperlich, Ronis, and Liberzon (2011) in a prospective three-cohort study involving 839 diverse nulliparas found that posttraumatic stress disorder (PTSD) mediated the relationship between maternal childhood maltreatment and infant birth weight.

Associations between pre-pregnancy obesity, perceived stress, mental health status and social support

Several studies have examined the association of pre-pregnancy obesity and psychosocial factors during pregnancy. Using a subset of data (n= 2,006) from Pregnancy, Infection and Nutrition (PIN) study, Laraia, Siega-Riz, Dole, and London (2009) found that pre-pregnancy obesity was independently associated with both perceived stress and depression during pregnancy after controlling for maternal race, education, marital status, number of children, income and age. In addition, they concluded that as pre-pregnancy weight increased, the women reported higher levels of perceived stress and depressive symptoms. In a cross-sectional study of 803 pregnant Korean women, Han, Ha, Park, Kim, and Lee (2011) found that the level of maternal stress was positively associated with pre-pregnancy BMI. Specifically, stress levels were significantly higher in the overweight and obese mothers than those in the underweight or normal weight groups ($p < 0.001$).

Other studies have supported the findings of Laraia et al. (2009) with regard to the association between pre-pregnancy BMI and depression during pregnancy. Bodnar, Wisner, Moses-Kolko, Sit, and Hanusa (2009) found a positive dose-response relationship between pre-pregnancy BMI and the likelihood of major depression during pregnancy ($p = 0.002$) after controlling for maternal education and gestational age. Compared with women who had a BMI of 18, the odds of depression among women with a BMI of 23, 28 and 33 were 1.4, 1.9 and 2.6 times higher respectively. In a small sample (n =139) of Taiwanese women undergoing elective cesarean section, Kuo, Chen, and Tzeng (2014) found that women who reported being overweight before pregnancy had twice the odds of having high levels of depression. Lacoursiere, Baksh, Bloebaum, and Varner (2006) examined the relationship between pre-

pregnancy BMI and postpartum depression. Using data from the 2000-2001 Utah Pregnancy Risk Assessment Monitoring System (PRAMS), they reported an increased prevalence of moderate to high depressive symptoms in those women who evidenced extremes of BMI. After controlling for marital status and income, the normal weight BMI category was associated with lowest prevalence (22.8%) of these symptoms. The highest prevalence of self-reported moderate or high depressive symptoms was found in the obese BMI category (30.8%) followed by the underweight BMI category at 27.7%. The overweight BMI category had a prevalence of 24.8%. While these studies suggest a relationship between psychosocial factors and pre-gravid weight status, the lack of data on potential confounders such as pre-pregnancy history of depression and other comorbid psychiatric conditions such as anxiety may lead to a false correlations between the pre-pregnancy BMI and depression. In addition, the lack of data prevents the exploration of the temporality of the association between pre-pregnancy BMI and depression. It is plausible that the causal pathway goes in either direction.

Though not during pregnancy, other studies have reported associations between BMI and psychosocial factors. Schur et al. (2013) reported that a higher BMI was significantly associated with higher perceived stress ($p = 0.1$) and depression scores ($p = .002$) in a sample of 1870 twins. This study used a continuous BMI score and did not classify BMI into categories. Using the Centers for Disease Control and Prevention Standards for BMI, Martyn-Nemeth and Penckofer (2012) compared the relationships among stress, depressive mood and social support between normal weight and overweight/obese racially and ethnically diverse adolescents. The Centers for Disease Control and Prevention Standards for BMI are: normal weight (5th to less than 85th percentile) and overweight/obese (85th or greater percentile) (Centers for Disease Control and Prevention, 2009). In this sample of 101, overweight/obese adolescents had higher depressive

and stress scores and lower social support scores than those adolescents in the normal BMI category. However, the differences were not statistically significant. Roenholt et al. (2012) examined the relationship between BMI and PTSD symptoms in a sample of 2,980 non-pregnant Danish young adults. They found that both underweight (BMI < 18.5) and obese (BMI \geq 30) participants reported significantly more PTSD symptoms than participants with a normal BMI (\geq 18.5 and < 25). These findings are similar to those reported by Lacoursiere et al. (2006), who also found psychiatric symptoms associated with the extremes of BMI.

In summary, research on the association between childhood maltreatment and obesity has been limited by its cross-sectional designs, absence of comparison groups, retrospective self-reports of childhood trauma and obesity and lack of standardized assessment techniques. However, the evidence supporting an association between childhood maltreatment and adult obesity has been consistent and significant. This association has not been affected by the measures or definitions used for maltreatment or obesity, or by confounding from childhood or adult socioeconomic status, current smoking, alcohol intake or physical activity. In contrast, studies examining childhood maltreatment and obesity in children, adolescents and young adults have been fewer and the findings less consistent. The research examining maternal childhood maltreatment and pregnancy-related obesity has been essentially absent except for two studies supporting the link between childhood maltreatment and later obesity. In addition to an association with childhood maltreatment, pre-pregnancy obesity has been directly linked to both high levels of perceived stress and depression. Several studies conducted outside of pregnancy have also found a similar relationship between high BMI, depression scores, perceived stress and low social support. Perceived stress and social support have also been identified as moderators of the relationship between childhood maltreatment and later obesity though not during pregnancy.

There is only a small group of studies exploring the relationship between a maternal history of childhood maltreatment and infant birth weight and they suggest an increased risk for smaller infants as opposed to larger infants which often accompany maternal obesity. This relationship appears to be most often mediated through several pathways including substance abuse, perceived stress, PTSD and depression. Research on the association of interpersonal trauma before and during pregnancy and infant birth weight also lends support to these findings with abuse-related stress as the mediational pathway. Currently, further empirical work is necessary to examine these processes and clarify the complex relationships among maternal childhood maltreatment, common psychosocial risk indices and differential infant birth weight outcomes.

Chapter 3

Research Design and Methodology

Introduction to the design

This dissertation study examined the associations among maternal childhood maltreatment, maternal obesity, infant birth weight, maternal stress, social support and mental health. It is a retrospective, secondary analysis of a subset of interview collected data from the prospective cohort study “Bio-behavioral Assessment of Stress in Adolescent Pregnancy: Perinatal Outcomes” (1R01MH077144-01A2, C. Monk, PI) (referred to as the parent study).

The parent study was a prospective, longitudinal observational study of pregnant adolescents which examined the effect of maternal prenatal stress, specifically, the association of their self-reported life stress, stress related changes in blood pressure (BP), and other biological indices of stress (cortisol, interleukin-6 (IL-6) and C-Reactive Protein (CRP)) on their birth outcomes. The pregnant teenagers underwent three 24-hour ambulatory BP monitoring periods with the simultaneous assessment of emotions and interpersonal interactions collected on a Personalized Digital Assistant Diary (PDA). At two points during the pregnancy, fetal heart rate and movement were assessed in response to a speech sound stimulus and while teenagers underwent a laboratory stressor. Newborn heart rate was assessed during an orthostatic challenge. Participants’ moods were assessed using standard self-report rating scales, and blood was drawn twice for analysis of cortisol and inflammatory markers. Salivary samples of cortisol were also collected during the three ambulatory collection periods and the two laboratory sessions to examine aspects of HPA-axis functioning that may be related to teenagers' stress and birth outcomes.

Methods

Design. This secondary analysis employed an exploratory correlational design. This design is well suited to this project as the goal was to determine associations among maternal childhood maltreatment (MCM), depression, PTSD, perceived stress and social support as the independent variables, and pre-pregnancy BMI as the outcome variable. An association between pre-pregnancy BMI and infant birth weight (IBW) was also explored.

Sample. This secondary data set was taken from the larger parent study data set. Participants for the parent study were recruited from obstetrical practices affiliated with Columbia University Medical Center (CUMC) and its satellite center, the Allen Pavilion. Inclusion criteria were as follows: 1) pregnancy in adolescence from the ages of 14-19 years, 2) nulliparous status-i.e. , first pregnancy intended to carry to term (participants may have had a previous abortion and/or miscarriage) 3) healthy pregnancy at time of enrollment, 4) participants in their 1st or 2nd trimester of pregnancy at enrollment, 5) delivery location at CUMC, 6) consent of parent or legal guardian for inclusion in the study, or in the case of emancipated minors and 18-year-old adolescents, self-consent for participation in the study. Exclusion criteria included: 1) potential participants' acknowledgement of smoking or use of recreational drugs in pregnancy; 2) twin gestation; 3) unhealthy fetal status; 4) chronic use of medication likely to affect blood pressure, including, but not limited to, nitrates, steroids, systematic migraine medications, stimulants and major and minor tranquilizers; 5) use of psychiatric medications; and 6) lack of fluency in English.

Procedures

Recruitment. The parent study used both direct and indirect methods for recruitment. The first method involved recruitment flyers posted around the CUMC campus. These flyers

were posted on public bulletin boards announcing the parent study and listing a phone number where potential participants could call for study details and further information. Upon phoning the research coordinator, potential participants received an explanation of the study and if they expressed interest in participating they were then screened according to the study criteria. An appointment was arranged with those who met criteria.

The second method was indirect and entailed partnering with the Department of Obstetrics and Gynecology at CUMC as gatekeepers to identify patients who might be eligible for the parent study. Staff from the department reviewed patient charts daily for those who might fit criteria for the study and upon identification of potential participants contacted them. Each potential participant then provided written permission for the staff to forward their contact information to the study coordinator. The study coordinator then followed up with phone calls to contacted potential participants to discuss the study. If they expressed an interest in participating, they were then screened according to the study criteria. If potential participants met the criteria, an initial study visit was scheduled.

Protocol for the parent study. Following clearance by the Institutional Review Board of the New York State Psychiatric Institute (NYSPI IRB), an informed consent procedure was conducted with each participant who provided written informed consent for study procedures as well as permission to collect data from her medical record in the immediate post-partum period. This recorded data included pregnancy birth outcomes (method of delivery, medications used, sex of the infant, infant's gestational age at birth, weight, length, head circumference, and APGAR scores).

Participants were scheduled for five integrated prenatal study sessions, which entailed eleven separate visits to the Behavioral Medicine Psychophysiology Laboratory on the 16th floor

of New York Presbyterian Hospital. These sessions included three ambulatory blood pressure (ABP) sessions involving three visits each and two fetal testing sessions. Two additional visits were scheduled for blood collection at the Clinical Research Center (CRC), part of the Irving Center for Clinical and Translational Research at New York Presbyterian Hospital. After the birth of the infant, a newborn session was arranged on the postpartum unit at CUMC. (See Appendix A for the parent study protocol schedule.)

Biological Measures

Specific biological measures and collection procedures from the parent study are outlined in Appendix B. For this dissertation study, the results of two measures were taken from the parent study battery of biological measures: pre-pregnancy BMI and infant birth weight.

Infant Birth Weight: Infant birth weight is defined as the recorded infant weight at birth as measured in grams. IBW was classified as large for gestational age (LGA) if it was greater than the 90th percentile based on the 2010 gender-specific weight for age intrauterine growth curves. This is an infant birth weight of greater than 4000 grams. (Olsen, Groveman, Lawson, Clark & Zemel, 2010)

Pre-pregnancy Body Mass Index (BMI): Pre-pregnancy BMI was calculated as weight in kilograms divided by height in meters squared. Self-reported pre-pregnancy weight and measured height were used to construct pre-pregnancy BMI. Weight status categories were defined using the revised Institute of Medicine (IOM) BMI cut points for pregnant women as follows: < 18.5 kg/m² (underweight), 18.5- 24.9 kg/m² (normal), 25.0-29.9 kg/m² (overweight), and ≥ 30 kg/m² (obese) (Rasmussen & Yaktine, 2009). Participants' pre-pregnancy BMI were classified as obese if it falls within the 2009 IOM weight categories.

Prenatal self-report questionnaires

In addition to the biological measures, a battery of psychosocial measures was collected in the parent study (See Appendix D). A number of these measures were chosen for analysis in the proposed study. These include: the Childhood Trauma Questionnaire (Bernstein & Fink, 1998), Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983), Symptom Checklist 90 –Revised (SCL-90-R) (Derogatis, 1977) and Social Support Questionnaire (Sarason, Levine, Basham, & Sarason, 1983). All of these measures were administered at the three ABP sessions and at home. A demographic data form was also completed which included information on the participant’s age at the beginning of the pregnancy, height, her weight prior to pregnancy and any history of pregnancy complications.

Childhood Trauma Questionnaire (Short form) (CTQ-SF). (Bernstein & Fink, 1998)

The CTQ-SF version was used to measure maternal childhood maltreatment (MCM), as an independent variable in this study. The 28-item scale is a self-report instrument that assesses emotional abuse (5 items), physical abuse (5 items), sexual abuse (5 items), emotional neglect (5 items), and physical neglect (5 items). The CTQ also contains a three-item Minimization/Denial subscale that is not used in analyses (Bernstein et al., 2003). Participants rate statements regarding traumatic childhood experiences on five-point Likert-type scales (“never true” to “very often true”). Most items are phrased in behavioral terms (e.g., “When I was growing up, someone touched me in a sexual way or made me touch them”), whereas some items require subjective evaluation (e.g., “When I was growing up, I believe I was sexually abused”). Abuse/neglect items are summed to yield scores on the individual subscales (emotional abuse, physical abuse, emotional neglect, physical neglect, and sexual abuse) with scores ranging from 5 to 25 for each. Clinical cut-off points have been validated and have sensitivity and specificity

at 0.85 or higher relative to clinical interview (therapists' ratings of childhood maltreatment (Bernstein, Ahluvalia, Pogge, & Handelsman, 1997). Subscales are classified as positive for abuse or neglect based on threshold scores for each: emotional abuse = 10, physical abuse = 8, sexual abuse = 8, emotional neglect = 15, and physical neglect = 8. If a score is at or above the clinical threshold on any one subscale, the individual is classified as having been exposed to any abuse or neglect. If scoring below clinical cutoff points for all subscales, an individual is classified as not exposed to abuse or neglect (Walker, Unutzer, et al., 1999). Psychometrics on the CTQ are good. It has been normed on African-American, Caucasian and Hispanic/Latino populations as well as a multi-ethnic adolescent population of 12-17 year-olds. The CTQ-SF demonstrates internal consistency ranging from a median of .66 to .92 across clinical and nonclinical samples. It shows good test-retest reliability (Pearson's $r = .88$) (Bernstein & Fink, 1998). The CTQ-SF also demonstrated evidence of criterion validity. When the CTQ Short Form's five latent maltreatment variables were compared to analogous therapist ratings of abuse and neglect from a subsample of 179 adolescent psychiatric patients, the correlations between the two measures ranged from .48 -.75 (Bernstein et al., 2003).

The Perceived Stress Scale (PSS-14). (Cohen et al., 1983) was used to measure the participants' perceived stress levels. It was designed to detect symptoms of global stress and assess the extent to which respondents find their lives unpredictable, uncontrollable, and overloaded over the previous month. The PSS-14 consists of fourteen items, which assess stressful feelings and thoughts during the last month and are scored on a 5-point likert scale from 1(never) to 5(very often). Scores are obtained by reversing the scores on the seven positive items (#4, 5, 6, 7, 9, 10, and 13, and then summing across all 14 items. Scores range on a continuum from 0-56 indicating increasing perception of stress. There is no specific clinical cutoff score.

The PSS has been correlated with depression, anxiety and physical symptomatology and shown to measure a different and independent predictive construct of appraised stress (Cohen & Williamson, 1988). The PSS has shown an internal consistency of 0.84 – 0.86. Test-retest reliability was evaluated using Pearson correlation coefficient yielding an $r = .85$ for a 2-day retest interval (Cohen et al., 1983).

The Social Support Questionnaire (SSQ). (Sarason et al., 1983) was used to assess the participant's level of social support. The SSQ quantifies the availability of and satisfaction with the social supports an individual has. It is a 27 item self-administered scale. Each item involves two components: 1) number of individuals who the participant considers supportive to him or her and 2) the participant's satisfaction with that support. The number (N) score for each item of the SSQ is the number of support persons listed. The social support available for a given problem is rated on a scale ranging from "very satisfied" to "very dissatisfied." This yields a satisfaction (S) score ranging from 1 to 6. The overall N and S scores are obtained by dividing the sum of N or S scores for all items by 27, the number of items. (Sarason, Sarason, Shearin, & Pierce, 1987). Higher overall number and satisfaction scores indicate increasing levels of social support and satisfaction with that support. There are no clinical cutoff scores for the SSQ. Criterion validity tests show significant negative correlations between the SSQ and the depression scale of the Multiple Adjective Affect Check List (MAACL) (Zuckerman & Lubin, 1965) ranging from -0.22 to -0.43. Also, additional correlations of 0.57 and 0.34 between Cantril's Ladder of Life Scale (Cantril, 1965), and SSQ satisfaction and number scores, respectively, suggest that people with high levels of social support are more optimistic about their current life situation than those low in social support. The Cronbach's alpha for internal reliability was 0.97. The inter-item

coefficient alpha was 0.94. Using Pearson's r , test-retest correlations of 0.90 for overall number scores and satisfaction scores of 0.83 were obtained (Sarason et al., 1983).

The Symptom Checklist 90 Revised (SCL-90-R). (Derogatis, 1977) was used to assess mental health status. The SCL-90-R is a multidimensional self-report questionnaire developed to screen for a range of psychological symptoms and psychopathological features. It is comprised of 90 items. Each item is rated by respondents on a five point Likert scale (0 to 4) as having caused them no distress ('not at all') to extreme distress ('extremely') during the past week. The instrument is scored on nine symptom subscales and three global indices of psychological distress. The symptom subscales are: somatization (SOM), obsessive-compulsive (O-C), interpersonal sensitivity (I-S), depression (DEP), anxiety (ANX), hostility (HOS), phobic anxiety (PHOB), paranoid ideation (PAR) and psychoticism (PSY). The three global indices of distress are: Global Severity Index (GSI), Positive Symptom Distress Index (PSDI) and Positive Symptom Total (PST). The Global Severity Index (GSI) measures the overall psychological distress. The Positive Symptom Distress Index (PSDI) measures the intensity of the symptoms. The Positive Symptom Total (PST) reports the number of self-reported symptoms. Derogatis, Rickels, and Rock (1976) reported internal consistency ranged from .77 to .90 for the SCL-90-R and concurrent validity with the Minnesota Multiphasic Inventory (MMPI). The SCL-R-90 also demonstrated good test-retest reliability at a 1-week interval (Pearson $r = .80$ to $.90$ for the subscales) (Derogatis, 1977). SCL-90-R has been normed on adult psychiatric inpatients and outpatients, adult non-patients as well as adolescent and adult non-patient groups.

This secondary analysis focused on the depression and PTSD distress subscales of the SCL-90-R. The depression subscale of the Symptom Checklist- 90- Revised (SCL-90R-D) is composed of 13 of the 90 items. The SCL-90R-D subscale score is calculated by averaging

participants' responses to each of the 13 items, with higher scores indicating more depressive symptoms. There is no set clinical cutoff score. The study sample depression subscale T score was converted to a standard T score using a norm group appropriate for the sample (non-patient adult females). The SCL-90R-D subscale has strong internal consistency ($\alpha = .90$) and good test-retest reliability over a period of 1 week (Pearson's $r = .82$) (Derogatis, 1977).

The SCL-90-R PTSD subscale developed by Saunders, Arata, and Kilpatrick (1990) includes 28 items from the original 90-item symptom inventory (See Table 1). A clinical cutoff raw score of 0.89 (T-score of 43.75) or above is indicative of a positive PTSD finding. The SCL-90-R PTSD subscale showed strong internal consistency ($\alpha = .93$) and was able to correctly classify 89% of the sample (Saunders et al., 1990). While a subsequent investigation (Carlozzi & Long, 2008) supports the strong psychometric properties of the SCL-90-R PTSD subscale, it suggests that this subscale is best conceptualized as one-dimensional measure for screening for distress associated with PTSD. It would not serve as a tool for assessing the three symptom clusters of PTSD (re-experiencing, avoidance and arousal).

Table 3.1

The SCL-90-R PTSD subscale items

Item Number	Item
3	Repeated unpleasant thoughts that won't leave your mind
12	Pains in heart or chest
13	Feeling afraid in open spaces or on the streets
14	Feeling low in energy or slowed down
17	Trembling
18	Feeling that most people cannot be trusted
23	Suddenly scared for no reason
24	Temper outburst that you could not control
28	Feeling blocked in getting things done
38	Having to do things really slowly to insure correctness
39	Heart pounding or racing
41	Feeling inferior to others
44	Trouble falling asleep
45	Having to check and double check what you do
51	Your mind going blank
54	Feeling hopeless about the future
56	Feeling weak in parts of your body
59	Thoughts of death and dying
66	Sleep through the night
68	Having ideas or beliefs that others do not share
70	Feeling uneasy in crowds, such as shopping or at a movie
79	Feelings of worthlessness
80	The feeling that something bad is going to happen to you.
81	Shouting or throwing things
82	Feeling afraid you will faint in public
84	Having thoughts about sex that bother you a lot
86	Thoughts and images of a frightening nature
89	Feeling of guilt

Table 3.2

Summary of variables analyzed in this study

Concept	Variable	Data type	How Measured
Early trauma	Maternal Childhood Maltreatment (MCM)	Dichotomous	Childhood Trauma Questionnaire
Stress	Perceived stress	Continuous	Perceived Stress Scale
Social Support	Perceived number of social support persons available	Continuous	Social Support Questionnaire
	Perceived satisfaction with support available	Continuous	
Mental Health Status	Depression	Continuous	SCL-90-R Depression subscale
	Posttraumatic Stress Disorder	Continuous	SCL-90-R PTSD subscale
Maternal obesity	Pre-pregnancy BMI	Dichotomous	2009 IOM BMI categories
Infant birth weight large for gestational age (LGA)	Infant birth weight in grams based on their gestational age	Dichotomous	2010 gender-specific for age intrauterine growth curves

Data Analysis

Data analysis included simple descriptive statistics, to bivariate analyses and on through multivariate analyses. Descriptive statistics including measures of central tendency (mean, median and mode), standard deviation, frequency distributions and percentages were computed to describe the demographic characteristics and study variables for all participants. Histograms were generated for visual review of the data. Correlation analyses were conducted for preliminary review of associations among variables of interest. All data were analyzed using STATA/MP 13 software (College Station, TX).

Aims and Hypotheses

The following aims and their corresponding hypotheses were examined as follows:

Aim I: The first aim was to explore associations among the variables of interest: maternal childhood maltreatment (MCM), maternal obesity and psychosocial risk indicators including depression, PTSD, stress and social support.

Hypothesis 1: MCM will be positively associated with maternal obesity defined as pre-pregnancy BMI ≥ 30 , depression, PTSD, and perceived stress and negatively associated with social support status.

Statistical Analysis Plan: Chi-square tests were employed to test for statistically significant differences in pre-pregnancy BMI between the childhood maltreated and the non-childhood maltreated groups. T-tests were employed to test if there are statistically significant differences in depression, PTSD, perceived stress and social support status between the childhood maltreated and the non-childhood maltreated groups.

Aim II: The second aim was to examine the predictive relationships among maternal childhood maltreatment (MCM), stress, psychiatric and social support status on maternal obesity in nulliparous adolescent mothers.

Hypothesis 2: MCM, higher levels of depression and PTSD symptoms, higher perceived stress levels and lower social support levels will independently predict pre-pregnancy BMI ≥ 30 after adjusting for the other covariates (MCM, depression, PTSD, perceived stress and social support status)

Statistical Analysis Plan: Logistic regression model construction was planned to examine the association between maternal childhood maltreatment, depression, PTSD, perceived stress and social support and the outcome, pre-pregnancy BMI. Stepwise selection procedures were designed to identify important predictors. Since each subject had between one and three measurements on depression, PTSD and perceived stress, the measurement taken at the

participant's entry into the parent study (first or second trimester of pregnancy) was entered into the model for these variables. In each model, the MCM was included regardless of its significance level.

$$\text{Log [pre-pregnancy BMI} \geq 30 / 1 - \text{pre-pregnancy BMI} \geq 30] = \beta_0 + \beta_1 * \text{MCM} + \beta_2$$

*higher level of depression symptoms + β_3 * higher level of PTSD symptoms + β_4

*higher perceived stress levels + β_5 *lower social support status

Exploratory aim: This exploratory aim was to explore the association between maternal obesity and infant birth weight (IBW).

Hypothesis: Pre-pregnancy BMI ≥ 30 will be positively associated with IBW greater than the 90th percentile for gestational age and gender (> 4000g).

Statistical Analysis Plan: Chi-square tests were employed to test for statistically significant differences in the birth weight of infants between the pre-pregnancy BMI ≥ 30 and the pre-pregnancy BMI < 30 groups.

Power/Sample size calculation

Preliminary power/sample size calculations for this dissertation study were conducted using the Wald test (Demidenko, 2007) for the logistic model with MCM alone as a predictor and for the model with both MCM and Positive Depression Screen as predictors. A power calculation for the first model indicated that a total sample of between 126 and 155 participants would be needed to detect a moderate effect size (OR= 2.5) with 80% power and an alpha level of .05. For the second model, the power calculation indicated a total sample of between 147 and 160 participants would be needed to detect a moderate effect size defined as an OR= 2.5 with 80% power and an alpha level of .05.

Protection of Human Subjects

Approval for the parent study was obtained from the Institutional Review Board of New York State Psychiatric Institute. Consent to participate in the parent study was obtained from the parent or legal guardian for participants under the age of 18 years. Participants over 18 and emancipated minors provided their own consent. Consents were in English as all study participants were fluent. Specific literacy issues were not discussed in the parent study. Approval to conduct a secondary analysis of a subset of previously collected interview data from the parent study was granted to this student investigator by the Institutional Review Board of New York State Psychiatric Institute. A Consent Form Waiver for this dissertation study was completed on RASCAL. Approval for this dissertation study was obtained from the Institutional Review Board Columbia University Medical Center (CUMC). There is no direct patient contact or observation for this dissertation study. This investigator complied with CUMC institutional human subject regulations in addition to all HIPAA regulations and state and federal laws that govern privacy and security.

Participant compensation. There was no compensation for use of records in this dissertation study. Participants in the parent study received \$68.00 for the first ambulatory blood pressure (ABP) session (\$50 for wearing the blood pressure monitor and \$18 for collecting cortisol samples), \$83.00 for the second ABP session (\$65 for ABP, \$18 for the cortisol samples), and \$98.00 for the third ABP (\$80 for ABP, \$18 for the cortisol samples). Participants received an additional \$.50 for each diary entry entered correctly during the ambulatory sessions for a total of \$36. They received \$30.00 for the fetal testing sessions as well as ultrasound pictures, and \$15 for each of the two blood draws. Participants received the compensation in cash. For the ABP sessions, participants received compensation on the third day when they came

back to the laboratory to drop off the second day of the cortisol samples. For the fetal testing sessions, blood draws, and newborns sessions, they received the compensation on the day of the session after the completion of the procedures. Participants who attended all sessions and completed all cortisol collections and diary entries received a total of \$375. Those participants that began the study in the second trimester of pregnancy receive a total of \$295. Participants who completed the newborn session received a gift valued at \$10.

Special Considerations

Inclusion of pregnant women and minorities. All data in this dissertation study were obtained from pregnant female participants who are predominantly Hispanic and African American.

Inclusion of children. Data used in this dissertation study were obtained from participants whose ages range from 14 -20 years old as well as the neonates born to these adolescent participants. The National Institute of Health defines children as anyone less than 21 years of age.

Chapter 4

Results

This chapter provides a summary of the characteristics of the study sample followed by the presentation of the study findings. The results of the statistical analyses used to test each hypothesis are detailed and presented by aim.

Characteristics of Study Sample

The sample for this dissertation study consisted of 131 pregnant adolescents, all of whom had been in the larger sample of 204 participants enrolled in the parent study, “Bio-behavioral Assessment of Stress in Adolescent Pregnancy: Perinatal Outcomes” (1R01MH077144-01A2, C. Monk, PI). Of all 204 participants in the parent study, only 131 had complete data sets for the variables investigated in this dissertation study.

Missing data may lead to bias and a loss of power. Imputation specifically, multiple imputation, is often useful for making use of incomplete case data. This dissertation study employed a number of survey instruments (Childhood Trauma Questionnaire, Perceived Stress Scale, Social Support Questionnaire, Symptom Checklist-90-Depression subscale, Symptom Checklist-90-PTSD subscale). Each survey instrument contained a large number of items, many of which are the basis for the variables used in the current study. With multiple surveys, each with a moderate amount of missing data, the development of suitable imputation models for the variables requiring imputation would be difficult. In particular, it is difficult to maintain the associations between all the survey variables (Brick & Kalton, 1996). Since suitable imputation models for the missing predictors in this study are necessary to make valid statistical inferences regarding their effect on the study outcome, imputation methods were not employed. However, bivariate analyses were conducted to assess whether those participants with complete data sets

were significantly different than those who did not. The analyses demonstrated that with the exception of depression and social support number, those participants who completed the study were not significantly different from those who did not on measures and demographic data (See Tables 4.8 and 4.9).

Demographic characteristics. Their ages ranged from 15-20 years at the time of the infant's birth with nearly half the sample between 19-20 years old. More than four-fifths (89.31%) of mothers self-identified as Hispanic/Latina. English was the primary language for approximately two-thirds of the mothers, while the remaining third of the mothers' primary language was Spanish.

Mothers' educational levels ranged from eighth grade to some college. Nearly three-quarters of the mothers had completed 11th or 12th grade. Approximately seventy-three percent of these mothers reported a family income of \$25,000 or less.

The mothers' relationships with the babies' fathers also varied. About 79 percent of the young women reported being in a relationship with their baby's father. Approximately 20 percent reported that they were not together with their baby's father. Eighty-eight percent of those young women were single and the remaining 12% were in another relationship. The demographic characteristics of this study sample are described in Table 4.1

Table 4.1

Demographic Characteristics of the Mothers in the Sample

Characteristic	n (%)
Mother's age at infant's birth (in years)	
15-16	8 (6.11 %)
17 -18	47 (35.88 %)
19-20	62 (47.33 %)
Unanswered	14 (10.68 %)
Ethnicity	
Not Hispanic/Latina	14 (10.69 %)
Hispanic/ Latina	117 (89.31 %)
Primary Language	
English	85 (64.89 %)
Spanish	45 (34.35 %)
Portuguese	1 (0.76 %)
Highest education level completed	
8 th grade	6 (4.58 %)
9 th – 10 th grade	27 (20.61 %)
11 th -12 th grade	96 (73.28 %)
Some college	1 (0.76 %)
Unanswered	1 (0.76 %)
Overall Family Income	
\$ 0 - \$15,000	50 (38.17 %)
\$16,000 - \$25,000	45 (34.35 %)
\$26,000 - \$50,000	25 (19.08 %)
\$51,000 – \$100,000	3 (2.29 %)
\$100,000 - \$250,000	1 (0.76 %)
Unanswered	7 (5.34 %)
Relationship with baby's father	
Together	104 (79.39 %)
Not together	26 (19.85 %)
Single	23 (88.46 %)
Other relationship	3 (11.54 %)
Unanswered	1 (0.76 %)

For the most part, the mothers were healthy primigravidas who experienced few pregnancy complications or adverse pregnancy outcomes. More than two-thirds (66%) of the mothers delivered by vaginal birth (Table 4.2).

Table 4.2

Pregnancy Complications and Outcomes

Complication/Outcome		n (%)
High Blood Pressure	<i>No</i>	126 (96.18%)
	<i>Yes</i>	2 (1.53 %)
	<i>Unanswered</i>	3 (2.29 %)
Diabetes	<i>No</i>	128 (97.7 %)
	<i>Yes</i>	0 (0 %)
	<i>Unanswered</i>	3 (2.3 %)
C-section	<i>No</i>	86 (65.65 %)
	<i>Yes</i>	30 (22.90 %)
	<i>Unanswered</i>	15 (11.45 %)

Findings related to maternal childhood maltreatment

Forty-three percent of this study sample had experienced childhood maltreatment. Childhood maltreatment includes physical abuse, sexual abuse, emotional abuse, and emotional neglect and physical neglect. Of the 43 % who experienced childhood maltreatment, 45% experienced physical abuse, 39% sexual abuse, and 61% emotional abuse. Forty-one percent experienced emotional neglect and 5% physical neglect. Fifty-two percent experienced multiple forms of abuse or neglect. Findings on maternal childhood maltreatment are summarized in

Table 4.3

Table 4.3

Findings on Maternal Childhood Maltreatment

Maternal Childhood Maltreatment	n (%)
Not Maltreated	75 (57.25)
Maltreated	56 (42.75)
Physical Abuse	25 (44.64)
Sexual Abuse	22 (39.29)
Emotional Abuse	34 (60.71)
Emotional Neglect	23 (41.07)
Physical Neglect	3 (5.36)
Multiple forms of abuse	29 (51.79)

Findings related to maternal obesity

While fifty-one percent of this study sample had a pre-pregnancy BMI that fell within the normal range, 40 percent entered pregnancy overweight or obese (See Table 4.4). In addition, the percentage of maltreated mothers that entered pregnancy overweight or obese was higher (44.56%) compared to the non-maltreated mothers (36%) (See Table 4.5).

Table 4.4

Findings related to maternal obesity

Pre-pregnancy BMI	n (%)
Underweight (< 18.5 kg/m ²)	12 (9.16)
Normal (18.5 – 24.9 kg/m ²)	67 (51.15)
Overweight (25 – 29.9 kg/m ²)	28 (21.37)
Obese (≥ 30 kg/m ²)	24 (18.32)
Overweight or obese Total=	52 (39.69)

Table 4.5

Findings on maternal obesity among maltreated vs. non-maltreated

Pre-pregnancy BMI	Maltreatment Status	
	Maltreated n (%)	Not maltreated n (%)
Overweight (25 – 29.9 kg/m ²)	13 (23.21)	15 (20)
Obese (≥ 30 kg/m ²)	12 (21.43)	12 (16)
Overweight or Obese Total =	25 (44.64)	27 (36)

Findings related to psychosocial variables

The average perceived stress score was 27.64 (SD =6.39) suggesting an increased level of perceived stress in this population. This is based on a norm group of females from 18 to 29 years of age whose mean score was 21.1 (SD = 7.2), the younger end of which corresponded to the age of participants in this study (Cohen & Williamson, 1988). The average depression score (normed) was 55.95 (SD = 8.84). This sample mean score though not of clinical magnitude is in

the 70th percentile based on a normed group of female adult non-patients whose mean score was 54 (Derogatis, 1977). The average PTSD score was 40.58 (SD = 6.63). Again, this score is not of clinical magnitude, falling below the clinical cut-off score of 43.67 (raw score: 0.89) for PTSD (Saunders, Arata, & Kilpatrick, 1990). The average number of support persons reported was 2.2 (SD = 1.4) suggesting a lack of support persons available to these mothers. This is based on a study by Compas, Slavin, Wagner, and Vannatta (1986) who reported a mean number of 3.7 (SD = 1.6) support persons in a sample of female young adult non-patients. However, despite the lack of support persons, the mothers in this sample were satisfied with the support received from those individuals reporting a mean social support satisfaction score of 5.5 (SD = 0.72). This is similar to the mean score of 5.1 (SD = 0.9) reported in the Compas study. Sarason et al. (1983) also reported a similar finding with a mean social support satisfaction score of 5.4 based on a mixed sample of males and females. Findings on the psychosocial measures are summarized in Table 4.6.

Table 4.6

Findings on Psychosocial Measures

Measure	Range	Sample Mean	SD	Comparison to non-clinical sample values
Perceived Stress Score	2-45	27.64 (r)	6.39	21.1
Depression Score	35-81	55.95 (t)	8.84	70 th percentile
PTSD score	32. 41-65.51	40.58 (t)	6.63	40.25
Social Support (number) Score	0-9	2.56 (r)	1.37	3.7
Social Support (satisfaction) Score	2.2-6	5.48 (r)	0.75	5.1

Note: r= raw score; t=T score

Correlations between variables

Correlations between study variables were assessed (Table 4.7). Moderate but significant correlations between perceived stress and PTSD as well as depression were detected ($r = 0.5126$, $r = 0.4458$; $p < 0.0001$). Depression and PTSD ($r = 0.6895$, $p < 0.0001$) were highly correlated even after deletion of items 54 and 79 from the SCL-90 PTSD subscale which overlapped with items on the SCL-90 depression subscale.

Table 4.7

Correlation matrix for study variables

	MCM	Pre-pregnancy BMI \geq 30	Perceived Stress	PTSD	Depression	Social Support Satisfaction	Social Support Number
MCM	1.0000						
Pre-pregnancy BMI \geq 30	0.0048 ^a	1.0000					
Perceived Stress	0.1846 ^b	-0.1860 ^b	1.0000				
PTSD	0.1983 ^b	-0.0627 ^b	0.5126^{*c}	1.0000			
Depression	0.2295 ^b	-0.0087 ^b	0.4458^{*c}	0.6895^{*c}	1.0000		
Social Support Satisfaction	-0.2889 ^b	-0.0169 ^b	-0.2429 ^c	-0.1899 ^c	-0.2007 ^c	1.000	
Social Support number	-0.2780 ^b	0.1608 ^b	-0.1594 ^c	-0.524 ^c	0.0478 ^c	0.2968 ^c	1.000

* $p < 0.0001$; ^a= Phi coefficient; ^b= Point biserial correlation; ^c= Pearson's r

Bivariate analyses for participant differences on missing data

There was missing data for 73 of the 204 study participants. Missing data decreased the sample size to 131. In order to assess whether the study participants who did complete the study were significantly different from those who did not, bivariate analyses using t-tests and Chi-Square tests were conducted on all variables examined in this study (See Tables 4.8 and 4.9). With the exception of depression ($p= 0.0147$) and social support number ($p= 0.0000$), those participants who completed the study were not significantly different from those who did not. These results are consistent with an assumption that the data are missing at random and the study appears not to be biased by the missingness. There is the potential however, that imputation on scales with partial responses would have increased power and narrowed confidence intervals.

Table 4.8

T-test analyses for participant differences on missing data

Study Variable	Mean(SD)		T-test	p value
	Study completed	Study not completed		
Maternal age at infant's birth	18.41(1.18)	18.22(1.24)	-0.9896	0.3243
MCM	37.77(13.89)	39.50(14.55)	0.7486	0.4559
Perceived stress	27.64(6.40)	27.48(7.04)	-0.1481	0.8825
PTSD	40.58(6.63)	38.97(4.75)	-1.7635	0.0806
Depression	55.95(8.84)	52.22(8.71)	-2.4932	0.0147
SSQ(number)	2.56(1.37)	1.60(1.25)	-5.0382	0.0000
SSQ(satisfaction)	5.48(0.75)	5.69(0.44)	1.9009	0.0632
Pre-pregnancy BMI	25.26(6.46)	25.85(5.75)	0.6352	0.5264
Infant birth weight (gms)	3213.84(522.13)	3077.89(686.99)	-1.3704	0.1736

Table 4.9

Chi-square analyses for participant differences on missing data

Study variable	Study Completion Status		χ^2	p
	Completed n (%)	Not Completed n (%)		
Ethnicity				
Not Hispanic/Latina	14 (10.69)	13 (19.12)	2.7131 ^a	0.100
Hispanic/ Latina	117 (89.31)	55 (80.88)		
Primary language				
English	85 (64.89)	46 (66.67)	0.5624 ^b	0.755
Spanish	45 (34.35)	23 (33.33)		
Portuguese	1 (0.76)	0 (0.00)		
Highest level of education				
8 th grade	6 (4.65)	1 (1.49)	3.2361 ^c	0.519
9 th grade	13 (10.08)	4 (5.97)		
10 th grade	14 (10.85)	10 (14.93)		
11 th grade	35 (27.13)	16 (23.88)		
12 th grade	61 (47.29)	36 (53.73)		
Overall Family Income				
\$ 0 - \$15,000	50 (40.32)	21 (38.18)	2.0192 ^c	0.732
\$16,000 - \$25,000	45 (36.29)	25 (45.45)		
\$26,000 - \$50,000	25 (20.16)	8 (14.55)		
\$51,000 – \$100,000	3 (2.42)	1 (1.82)		
\$100,000 - \$250,000	1 (0.81)	0 (0.00)		
Relationship with baby's father				
Together	104 (80.00)	55 (83.33)	0.3176 ^a	0.573
Not together	26 (20.00)	11 (16.67)		

df: degrees of freedom; ^a = 1df ; ^b= 2df; ^c = 4df**Results of statistical analyses related to aims and hypotheses****Aim I**

The first aim of this study was to explore associations among the variables of interest: maternal childhood maltreatment (MCM), maternal obesity and psychosocial risk indicators

including depression, PTSD, stress and social support. Bivariate analyses (Chi-Square and t-tests) were utilized to assess for differences in pre-pregnancy BMI and psychosocial risk indicators between mothers with a history of childhood maltreatment and mothers without a history of childhood maltreatment.

Hypothesis 1: MCM will be positively associated with maternal obesity defined as pre-pregnancy BMI ≥ 30 , depression, PTSD, and perceived stress and negatively associated with social support status.

Bivariate analysis using a Pearson Chi-Square test was performed to examine the relationship of these dichotomous variables, MCM (non-maltreated/maltreated) and pre-pregnancy BMI (BMI < 30/ BMI ≥ 30). The proportion of mothers from the maltreated group who had a higher pre-pregnancy BMI (≥ 30) was greater (0.214) than that from the non-maltreated group (0.16). This difference between MCM and pre-pregnancy BMI, while in a positive direction was not statistically significant, $\chi^2(1, N = 131) = 0.6314, p = 0.427$. (See Table 4.10)

Table 4.10

Bivariate analyses of association between pre-pregnancy BMI and maternal childhood maltreatment (MCM)

Pre-pregnancy BMI	Maternal Childhood Maltreatment Status		$\chi^2(1)^*$	<i>p</i>
	MCM n (%)	No MCM n (%)		
BMI < 30	44 (78.57)	63 (84.00)	0.6314	0.427
BMI ≥ 30	12 (21.43)	12 (16.00)		

*Pearson χ^2 between maltreated/ non-maltreated groups

Two-sample t-tests with unequal variances were conducted to compare depression, PTSD, perceived stress and social support scores in mothers with MCM and those without MCM. All findings were significant, such that depression, PTSD, and perceived stress scores were all higher in mothers with a history of MCM and social support scores lower in this group when compared with non-MCM mothers. Specific results on these analyses for MCM vs. non-MCM mothers were as follows: depression ($t(123.54) = -2.7229, p = 0.0074$); PTSD ($t(118.42) = -2.3058, p = 0.0229$); perceived stress ($t(123.81) = -2.1708, p = 0.0319$); number of social support persons ($t(127.56) = 3.4908, p = 0.0007$) and satisfaction with social support ($t(87.08) = 3.2331, p = 0.0017$). See Table 4.11 for scores and results of all bivariate analyses for MCM on psychosocial variables.

Table 4.11

Bivariate analyses testing for differences in means between mothers with maternal childhood maltreatment and mothers without maternal childhood maltreatment on psychosocial variables

Variable	N	Mean (SD)		T-score
		<i>MCM</i>	<i>No MCM</i>	
Depression	131	58.30 (8.21)	54.2 (8.94)	-2.7229**
PTSD	131	42.10 (6.54)	39.44 (6.51)	-2.3058*
Perceived Stress	131	29.00 (5.97)	26.62 (6.54)	-2.1708*
Social Support (# of persons)	131	2.11 (1.01)	2.88 (1.51)	3.4908***
Social Support (Satisfaction with Support)	131	5.22 (0.89)	5.67 (0.57)	3.2331**

T-tests with unequal variances; * $p < .05$, ** $p < .01$, *** $p < .001$

Aim II

The second aim of this study was to examine the predictive association for maternal childhood maltreatment (MCM), perceived stress, social support and psychiatric status on maternal obesity in nulliparous adolescents.

***Hypothesis 2:** MCM, higher levels of depression and PTSD symptoms, higher perceived stress levels and lower social support levels will independently predict pre-pregnancy BMI ≥ 30 after adjusting for the other covariates in the model.*

As this was an exploratory study, a logistic regression procedure that included all predictor variables in the model was performed first.

Model including all predictor variables

Findings of this full model analysis were not statistically significant, but were in a positive direction as predicted. Mothers who experienced childhood maltreatment were 2.1 (OR=2.121, 95%CI: 0.752 - 5.989, $p = 0.155$) times as likely to have a pre-pregnancy BMI equal to or greater than 30 when compared to mothers without MCM. This directional relationship also existed with respect to the association between depression and BMI (OR: 1.02, 95% CI = 0.941 – 1.106, $p = 0.625$). Conversely, those who had higher levels of satisfaction with social support had a decreased likelihood of higher pre-pregnancy BMI (≥ 30) (OR: 0.77, 95%CI: 0.390 - 1.520, $p = 0.451$).

Findings which were inconsistent with the above hypothesis include those related to PTSD, perceived stress and absolute number of social supports in the environment regardless of satisfaction with that support. Higher PTSD levels in the mother were found to decrease the likelihood of having a higher pre-pregnancy BMI (≥ 30) (OR: 0.99, 95%CI: 0.887 – 1.102, $p = 0.84$). Similarly, higher levels of perceived stress in the mother also decreased the likelihood of

having higher pre-pregnancy BMI (≥ 30) (OR: 0.91, 95% CI: 0.836 – 0.998, $p = .05$). Both of these results were inconsistent with the above hypothesis, with the finding for perceived stress reaching statistical significance. With respect to the amount of social support, mothers with a higher number of support persons were 1.4 times (OR: 1.365, 95% CI: 0.974 – 1.914, $p = 0.071$) more likely to have a higher pre-pregnancy BMI (≥ 30). Although not statistically significant, this finding is also inconsistent with the hypothesis that mothers with a lower number of support persons are more likely to have a pre-pregnancy BMI ≥ 30 . See Table 4.12 for a summary of results for the full logistic regression model.

Table 4.12

Full logistic regression model: pre-pregnancy BMI ≥ 30

				Number of observations = 131
				LR χ^2 (6) = 10.29
				Prob > χ^2 = 0.1130
				Pseudo R ² = 0.0825
Log likelihood = - 57.240934				
Variable	Odds ratio	z	p value	95% Confidence Limits
MCM	2.121	1.42	0.155	0.752 - 5.989
Perceived Stress	0.914	-2.00	0.045	0.836 – 0.998
PTSD	0.989	-0.20	0.838	0.887 – 1.102
Depression	1.020	0.49	0.625	0.941 – 1.106
Social Support (number)	1.365	1.81	0.071	0.974 – 1.914
Social Support (satisfaction)	0.770	-0.75	0.451	0.390 - 1.520

Additional stepwise selection procedures were performed to identify a potentially smaller set of predictors for pre-pregnancy obesity ($BMI \geq 30$). Both backward and forward elimination regression procedures were performed and the Hosmer Lemeshow goodness-of-fit test used to fit the final model. With respect to choice of significance levels, Hosmer and Lemeshow (2004) report that using the standard significance value of 0.05 for selection of variables for a model may be too stringent often excluding important variables. They propose using a range from 0.15 - 0.30. In addition, the p value for removal of variables from a model must exceed the p value for entry of variables to guard against the possibility of having the stepwise procedure enter and remove the same variable at successive steps. These Hosmer Lemeshow guidelines were used in these analyses. The MCM variable remained in the models regardless of significance level.

Backward elimination model

The backward elimination regression procedure began with all predictor variables for pre-pregnancy $BMI \geq 30$ in the model. Variables were removed if their p value was greater than or equal to 0.30 (Hosmer & Lemeshow, 2004). Given this criteria, the following variables were eliminated from the model: PTSD ($p = 0.8379$), Depression ($p = 0.6490$) and Social support (satisfaction) ($p = 0.4191$).

This backward elimination model suggests that mothers who experienced childhood maltreatment were 2.4 times (OR: 2.363, 95% CI: 0.866 -6.449, $p = 0.093$) as likely to have a higher pre-pregnancy $BMI (\geq 30)$ when compared to mothers without MCM. This result is slightly higher than that found in the full model. This finding regarding the hypothesis that MCM predicts higher BMI was also not statistically significant, but is in a positive direction as predicted.

As in the full model analysis, findings that were inconsistent with hypothesis 2 included those related to perceived stress and absolute number of social supports in the environment regardless of satisfaction with that support. Higher levels of perceived stress in the mother were found to decrease the likelihood of having had a higher pre-pregnancy BMI (≥ 30) (OR: 0.93, 95% CI: 0.859 - 0.997, $p = 0.04$). This statistically significant finding was inconsistent with the above hypothesis. Similarly, with respect to the amount of social support, mothers with a higher number of support persons were 1.4 (OR: 1.359, 95%CI: 0.980 -1.833). Although insignificant, this finding is also inconsistent with the hypothesis that mothers with a lower number of support persons are more likely to have a pre-pregnancy BMI ≥ 30 . See Table 4.13 for a summary of results for the backward elimination procedure

Table 4.13

Backward elimination logistic regression model: pre-pregnancy BMI ≥ 30

Number of observations = 131
 LR $\chi^2(6)$ = 9.42
 Prob > χ^2 = 0.0242
 Pseudo R² = 0.0755

Log likelihood = - 57.673001

Variable	Odds ratio	z	p value	95% Confidence Limits
MCM	2.363	1.68	0.093	0.866 -6.449
Perceived Stress	0.925	-2.05	0.041*	0.859 - 0.997
Social Support (number)	1.359	1.84	0.066	0.980 - 1.833

Note: $p = 0.8379 \geq 0.30$ removing PTSD
 $p = 0.6490 \geq 0.30$ removing Depression
 $p = 0.4191 \geq 0.30$ removing SSQ (satisfaction)

* $p < .05$

Forward selection model

The forward selection procedure was also performed for this exploratory study. Variables were added to the model if they had a p value less than 0.25. This p value for entry into the model is less than the p value of 0.30 for removal to prevent the infinite loop of entry and removal (Hosmer & Lemeshow, 2004). The MCM variable was entered into the model regardless of its significance level. The following variables were added to the model as their p values were less than 0.25: Perceived stress ($p = 0.02371$ and Social support (number) ($p = 0.0659$). PTSD and Depression were not added to the model as their p values were greater than 0.25. The results from this forward selection model are identical to those found in the backwards elimination model. See Table 4.14 for a summary of results for the forward selection procedure.

Table 4.14

Forward selection logistic regression model: pre-pregnancy BMI ≥ 30

Number of observations = 131
 LR $\chi^2(6)$ = 9.42
 Prob > χ^2 = 0.0242
 Pseudo R² = 0.0755

Log likelihood = - 57.673001

Variable	Odds ratio	z	p value	95% Confidence Limits
MCM	2.363	1.68	0.093	0.866 - 6.449
Perceived Stress	0.925	-2.05	0.041*	0.859 - 0.997
Social Support (number)	1.359	1.84	0.066	0.980 - 1.883

Note: $p = 0.0237 < 0.25$ adding Perceived Stress
 $p = 0.0659 < 0.25$ adding Social Support (number)
 * $p < .05$

The backward elimination and forward selection overall models were both statistically significant ($\text{Prob} > \chi^2 = 0.0242$) and yielded an identical final model. In order to evaluate whether the final model obtained was well calibrated so that probability predictions from the model reflected the occurrence of events in the data set, a Hosmer Lemeshow goodness-of-fit test was performed. The p-value for the Hosmer Lemeshow goodness-of-fit test was 0.9894 which is greater than 0.05, indicating that the model was a good fit as actual and expected events in the model were not statistically different. See Table 4.15 for a summary of the Hosmer Lemeshow procedures and goodness-of-fit test.

Table 4.15

Logistic model for pre-pregnancy BMI ≥ 30 , Hosmer Lemeshow Goodness-of-Fit Test

Group	Prob	Pre-pregnancy BMI ≥ 30		Pre-pregnancy BMI < 30		Total
		Observed_1	Expected_1	Observed_0	Expected_0	
1	0.0681	0	0.8	14	13.2	14
2	0.1053	1	1.2	12	11.8	13
3	0.1214	2	1.5	11	11.5	13
4	0.1373	2	1.7	11	11.3	13
5	0.1567	2	1.9	11	11.1	13
6	0.1824	2	2.2	11	10.8	13
7	0.2121	3	2.6	10	10.4	13
8	0.2487	3	3.3	11	10.7	14
9	0.2892	4	3.2	8	8.8	12
10	0.6369	5	5.6	8	7.4	13

Note: Number of observations = 131
Number of groups = 10
Hosmer Lemeshow $\chi^2 (8) = 1.67$
 $\text{Prob} > \chi^2 = 0.9894$

Exploratory Aim

The third aim of this study was to explore the association between maternal obesity and infant birth weight (IBW).

Hypothesis: Pre-pregnancy BMI ≥ 30 will be positively associated with IBW greater than the 90th percentile for gestational age and gender ($> 4000\text{g}$).

Bivariate analysis using a Pearson Chi-Square test was performed to examine the relationship between pre-pregnancy BMI and infant birth weight. The proportion of mothers from the pre-pregnancy BMI ≥ 30 group that had an infant whose birth weight was greater than 4000 grams was slightly higher (0.0541) compared to the proportion from the BMI < 30 group (0.0301) (Table 4.16). This difference in proportions was not statistically significant, $\chi^2 (1, N = 170) = 0.4888, p = 0.484$.

Table 4.16

Bivariate Analysis of pre-pregnancy BMI and infant birth weight (IBW) > 4000 grams

Infant Birth Weight	Pre-pregnancy BMI		$\chi^2 (1)^*$	<i>p</i>
	BMI < 30 n (%)	BMI ≥ 30 n (%)		
> 4000 grams	4 (3.01)	2 (5.41)	0.4888	0.484
≤ 4000 grams	129 (96.99)	35 (94.59)		

*Pearson χ^2 between pre-pregnancy BMI < 30 and pre-pregnancy BMI ≥ 30 groups.

Based on associations among maternal childhood maltreatment, maternal obesity and infant birth weight in the literature, a post-hoc analysis examining pre-pregnancy BMI ≥ 30 and low infant birth weight (LBW)($< 2500\text{g}$) was also conducted. See Table 4.17 for findings.

Table 4.17

Bivariate Analysis of Pre-pregnancy BMI and Infant Birth Weight (IBW) < 2500 grams

Infant Birth Weight	Pre-pregnancy BMI		$\chi^2 (1)^*$	<i>p</i>
	BMI < 30 n (%)	BMI \geq 30 n (%)		
\geq 2500 grams	141 (90.97)	36 (97.30)	1.6616	0.197
< 2500 grams	14 (9.03)	1 (2.70)		

*Pearson χ^2 between pre-pregnancy BMI < 30 and pre-pregnancy BMI \geq 30 groups.

Chapter 5

Discussion

This is one of the first research studies to explore associations between an early history of childhood maltreatment and other correlated risk factors for obesity in the context of pregnancy (Diesel, Bodnar, Day, & Larkby, 2014; Hollingsworth, Callaway, Duhig, Matheson, & Scott, 2012). Moreover, it is the first investigation to examine these relationships in an urban sample of young adult Latina nulliparas characterized by health disparities. The findings of this study have demonstrated a high occurrence of childhood maltreatment, with 45% of the study sample experiencing at least one form of abuse. A similarly high percentage (41 %) of pre-pregnancy overweight and obesity (BMI ≥ 25 and BMI ≥ 30 respectively) was also evidenced. Significant psychosocial correlates for childhood maltreatment and maternal obesity in this group were identified and can serve to inform the development and implementation of systematic prenatal screening programs for populations at psychosocial risk. Lastly, the finding that a maternal history of childhood maltreatment (MCM) increased the odds of pre-pregnancy obesity by two-fold in this sample is of significant clinical import. Both of these public health concerns confer a heightened risk for additional short and long-term adverse health outcomes for mothers and infants, especially those already compromised by health disparities.

This chapter provides a discussion of the key findings of this study as compared with those in the extant literature, addresses discrepancies and provides clinical and policy implications as well as suggestions for future research.

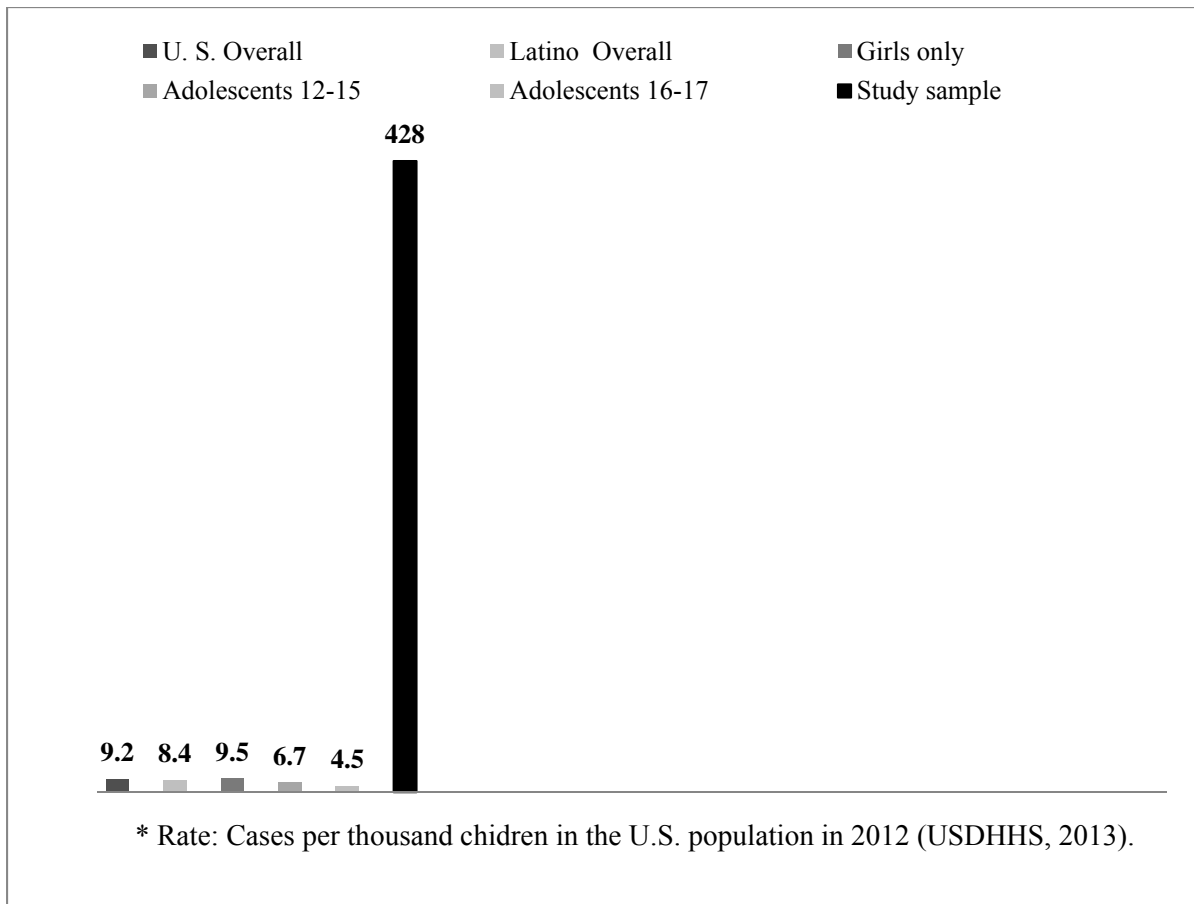
Descriptive findings on study variables

When compared to a national rate of 9.2 cases of at least one form of childhood maltreatment per thousand children in the U. S. population (U.S. Department of Health and

Human Services, 2013), this dissertation study sample revealed a comparison rate of 428 cases of at least one form of childhood maltreatment (MCM) per thousand children in the population. While this finding is compelling, representing 43% (56/131) of this study sample, it must be noted that these cases of childhood maltreatment are based on self-report while the national rate is based on substantiated cases. When compared to the national rate of 9.2 cases of at least one form of childhood maltreatment per thousand children in the U.S. population, the reported rate for girls is higher at 9.5 cases. Adolescents aged 12-15 years and 16-17 years have rates that are lower than the national rate at 6.7 cases and 4.5 cases respectively. Rates for Latinos overall are also lower than the national rate at 8.4 cases per thousand children in the population. (U.S. Department of Health and Human Services, 2013). However, accurate comparisons with this study sample are difficult. As mentioned previously, cases of childhood maltreatment in this study sample are based on self-report while the national rates are based on substantiated cases. In addition, specific information in the national data set on childhood maltreatment rates for adolescents aged 18-19 years is lacking, the age group that constituted a large part of this study sample. Additionally, the national rate of childhood maltreatment reported for Latinos is (8.4 cases per thousand) is not stratified by age and rates reported for the adolescent age groups (6.7 and 4.5 cases per thousand) were not stratified by gender (See Figure 5.1). However, it should be noted that since abuse is often under-reported, the actual national rates cited by the U.S. Department of Health and Human Services(2013) are most likely lower than the actual rates.

Figure 5.1

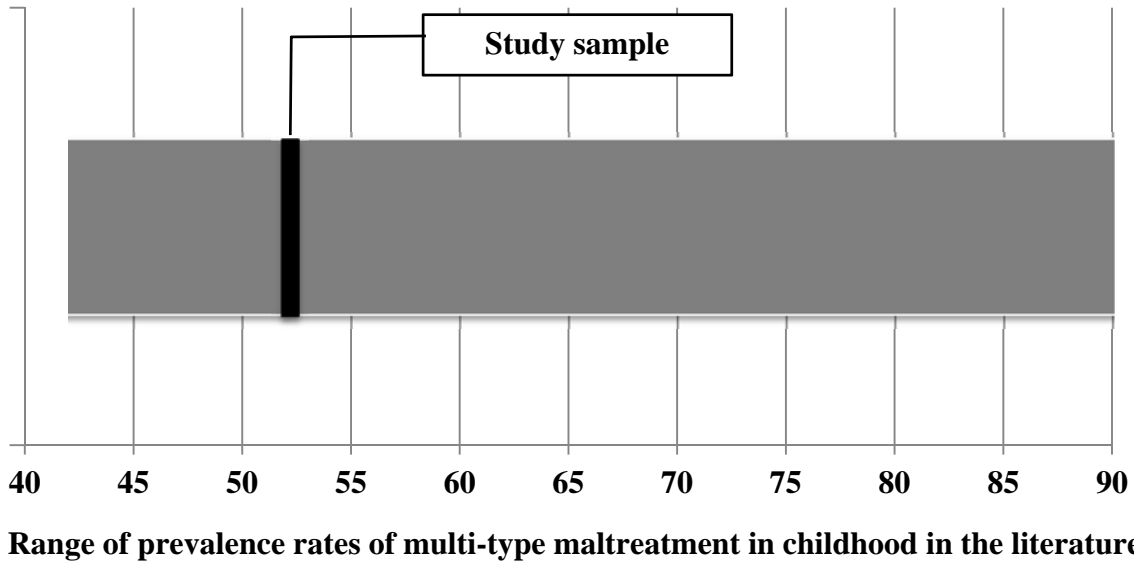
National and Study Sample rates of at least one type of child maltreatment



Of particular importance are the numbers of maltreated mothers experiencing multiple forms of childhood abuse and neglect (multi-type childhood maltreatment). Fifty-two percent (29/56) of the maltreated mothers in this sample experienced multi-type maltreatment in childhood. This percentage falls within the midrange of general prevalence rates (43-90%) for young adults reported in the literature (Higgins & McCabe, 2000; McGee, Wolfe, Yuen, Wilson, & Carnochan, 1995; Sesar, Simic, & Barisic, 2010)(See Figure 5.2).

Figure 5.2

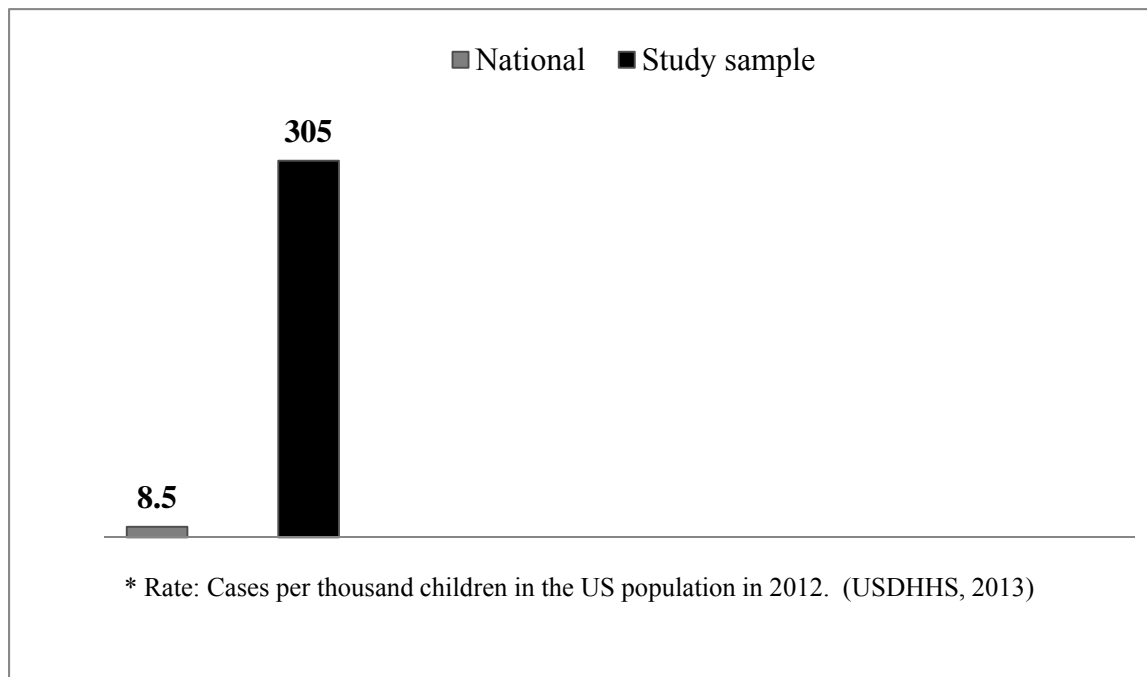
Prevalence rates of multiple forms of childhood maltreatment among the maltreated mothers



However, one type of maltreatment, psychological maltreatment encompassing emotional abuse and/or neglect, was reported at a much higher rate than seen in the general population. For comparison purposes, the rate found here is in the order of 305 cases per thousand compared to a national rate of 8.5 cases per thousand children in the population (U.S. Department of Health and Human Services, 2013(See Figure 5.3). Representing 31% (62/131) of this study sample, this finding is also based on self-report. Again, this is compared to substantiated cases in the national dataset, a rate which is also most likely low because of underreporting and difficulties in substantiation with respect to psychological maltreatment. In addition, no information is available in the national dataset regarding the rates of psychological maltreatment for the Latina population as a whole, and Latina adolescent girls 12-19 years of age in particular. Therefore an accurate comparison to this study sample is not possible.

Figure 5.3

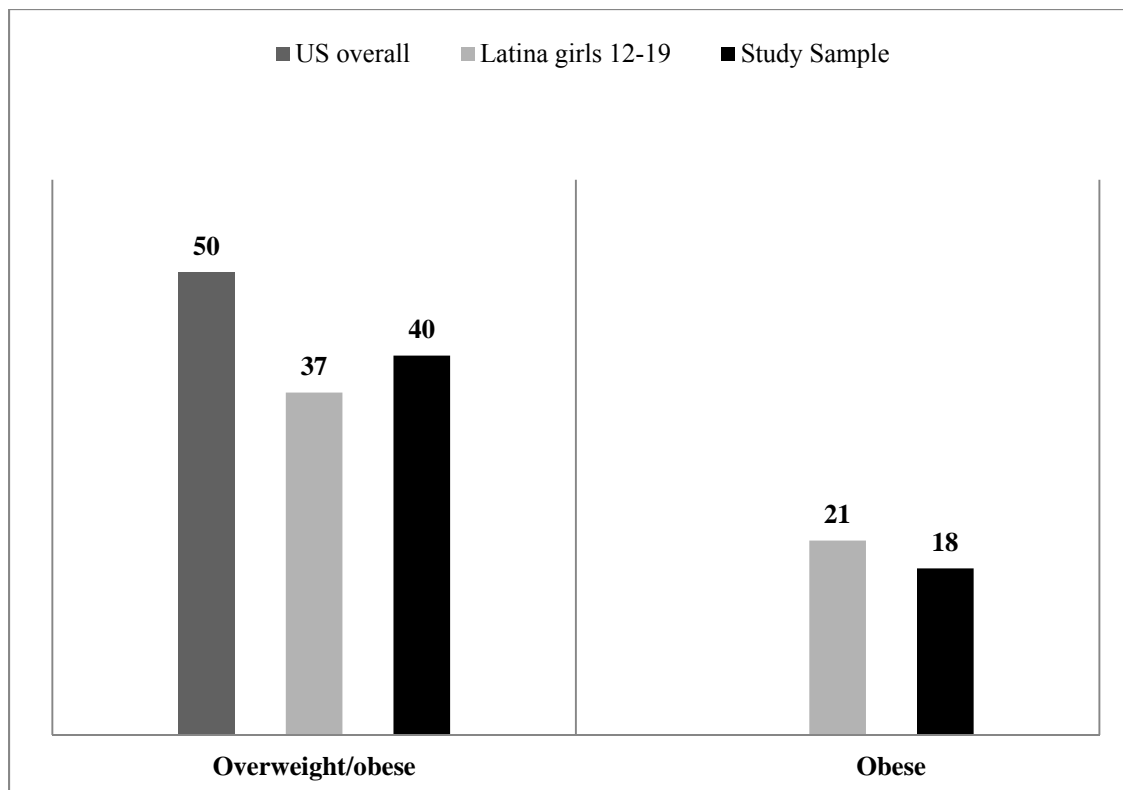
Rates of psychological maltreatment



Moreover, 40 percent of this relatively small study sample began their pregnancies either overweight or obese (pre-pregnancy BMI ≥ 25 and ≥ 30 respectively). This finding is slightly lower than reported prevalence of 50% in the United States as a whole (across all age groups), but higher than the national prevalence of 37% among Latina women 12-19 years of age (Vesco et al., 2009). Additionally, 18 % of this study sample began their pregnancies in the higher risk obese category. This result is roughly equivalent to the national prevalence of 21 % among Latina women aged 12 to 19 years. (Fryar, C., Carroll, M., & Ogden, C., 2014)(See Figure 5.4).

Figure 5.4

Percentage of women entering pregnancy overweight or obese



Among the maltreated mothers in this study sample, 45 % began their pregnancies overweight or obese compared with 36 % in the non-maltreated group. Of this group, 21 % were in the obese category compared to 16 % in the non-maltreated group. In this sample, the rates of overweight and obesity were higher across the board in the maltreated group.

With respect to psychosocial indices, all of which were administered antenatally, this young minority sample reported elevated levels of perceived stress and lower levels of social support. These findings are in concordance with the extant literature that includes the small body of research finding heightened levels of perceived stress among survivors of childhood maltreatment along with significantly lower levels of social support (Bell & Belicki, 1998;

Hyman et al., 2007; Schumm et al., 2005; Vranceanu et al., 2007 Sperry & Widom, 2013). In contrast, while previous studies (Brown et al., 1999; Harkness et al., 2012; Nanni, et al., 2012; Seng et al., 2009; Widom et al., 2007; Vranceanu et al., 2007) have suggested an increased risk for both depression and PTSD in victims of childhood maltreatment, this study sample did not reach levels of clinical magnitude for depression or PTSD. Possible reasons for this discrepancy may be related to measurement or methodological differences in the studies. The previous studies used structured psychiatric diagnostic interview schedules such as National Institute of Mental Health Diagnostic Interview Schedule and the PTSD Symptom Scale –Interview that were administered by trained individuals to measure depression and PTSD. This dissertation study measured depression and PTSD using subscales from the SCL-90 Revised, which is a self-report instrument used to evaluate a broad range of psychological problems and symptoms of psychopathology. Additional explanations may be due to methodological differences. The majority of the previous studies were prospective cohort studies which allow for measurement over time, whereas this dissertation study was cross-sectional, representing information at one period in time.

The high proportions of childhood maltreatment and pre-pregnancy obesity evidenced in this study are quite concerning in light of the national statistics yet not totally unexpected in this sample of minority young adults characterized by health disparities. From these descriptive findings regarding high perceived stress and low social support, it appears that a profile of risk already may already exist for these young women that operates through a number of channels and includes other related indices. These were examined in this study and are discussed in the following sections.

Associations among MCM, maternal obesity and psychosocial risk factors

It was hypothesized that MCM would be positively associated with maternal obesity, depression, PTSD, and perceived stress and negatively associated with social support status. All associations were found to be statistically significant with the exception of the association between maternal childhood maltreatment and maternal obesity, which was statistically non-significant but in a positive direction as predicted. These findings are particularly important because while these associations have been well established in the general medical literature (Bell & Belicki, 1998; Brown et al., 1999; Elliott et al., 2005; Gracia & Musitu, 2003; Harkness et al., 2012; Heim et al., 2001; Hyman et al., 2007; McEwen, 1998; Nanni et al., 2012; Nooner et al., 2012; Pine, 2003; Schumm et al., 2005; Sperry & Widom, 2013; Vranceanu et al., 2007; Widom, 1999; Widom, DuMont, & Czaja, 2007), they have rarely been examined in the context of pregnancy. With the exception of a study by Seng et al. (2009) which examined the singular relationship of child maltreatment and PTSD in first time mothers, no other study has examined these multiple relationships in the context of pregnancy.

Examination of these relationships is important in allowing us to more closely examine this complex and multifaceted issue. Additionally, the systematic assessment of these psychosocial risk factors (perceived stress, depression, PTSD and social support status) with respect to maternal childhood maltreatment (MCM) is a significant determinant of the accuracy to which MCM's impact on pre-pregnancy obesity can be estimated statistically. Findings regarding MCM and other relevant predictors of pre-pregnancy obesity are discussed below.

Risk profile for pre-pregnancy obesity

The identification of risk indicators for pre-pregnancy obesity is an important first step in the development of systematic prenatal screening tools and interventions with high risk groups. It

was hypothesized that MCM, along with higher levels of depression, PTSD symptoms, and perceived stress levels as well as lower social support levels would independently predict higher pre-pregnancy BMI.

The logistic regression analyses produced two important findings. First, a model containing maternal childhood maltreatment, perceived stress and number of social support persons available to the mother was the best fit for predicting pre-pregnancy obesity risk status. The primary variable of interest in this study, maternal childhood maltreatment as a predictor of pre-pregnancy obesity was less than the exploratory p value of .10. In the final stepwise logistic regression model, the p-value for maternal childhood maltreatment was 0.09. It is likely that, with a sample size larger than the 131 subjects included the model, stratification of the binomial (maltreated/not maltreated) maternal childhood maltreatment variable into levels of severity may have been possible. The addition of a severity index may well have increased the model's ability to identify a statistically significant effect of maltreatment on pre-pregnancy obesity at the higher end of the range.

It should be emphasized that the finding regarding MCM is of significant clinical importance because, despite the limitation regarding measurement of maltreatment severity, it confers on the maltreated mother a risk of obesity more than double that of non-maltreated mothers. With that risk also comes the potential threat for additional adverse health outcomes such as gestational diabetes, preeclampsia, operative and premature deliveries, shorter breastfeeding durations and postpartum weight retention which may lead to obesity later in life (Amir & Donath, 2007; Dietz, et al., 2005; Gabbe & Graves, 2003; Leddy, Power, & Schulkin, 2008; Nohr et al., 2008; O'Brien et al., 2003; Siega-Riz et al., 2009). The potential risks for the offspring of these mothers are no less ominous. There are increased risks for fetal birth defects

such as neural tube defects, stillbirths and fetal injuries during delivery such Erb's palsy or brachial plexus injury related as well as childhood overweight and obesity (Catalano & Ehrenberg, 2006; Castro & Avina, 2002; Guelinckx et al., 2008; Leddy et al., 2008; Smith et al., 2008; Vasudevan et al., 2011; Yogev & Catalano, 2009).

The finding that higher levels of perceived stress in the mother were found to decrease the likelihood of having a higher pre-pregnancy BMI (≥ 30) did not support the a priori hypothesis in this study. A possible explanation for this result is that the stress reported by the mothers in this study was of a more acute nature rather than a chronic one. Torres and Nowson (2007) concluded that stress appears to effect human eating behavior predominantly through two response pathways. Responses to acute stress stimulate physiological changes that are associated with reduced food intake in the short term, such as delayed gastric emptying and shunting of blood away from the gastrointestinal tract. By contrast, responses to chronic stress stimulate a response from the HPA axis which increases the production of cortisol that may lead to the overconsumption of energy dense foods and potentially lead to weight gain and obesity. The perceived stress reported by the study participants was measured using Cohen's Perceived Stress Scale. This instrument was designed to detect symptoms of stress experienced over the previous month. This rather short assessment window prevents any differentiation of chronic vs. short term stress, thus precluding examination of this question. While the group as a whole did report high rates of early maltreatment, longitudinal mapping of this type of toxic stress and subsequent stressors would be necessary in this regard.

The study finding that high numbers of available support persons increased the risk of pre-pregnancy obesity was also inconsistent with our hypothesized expectation. Reasons for this discrepancy may be due in part to the fact that this young adult Hispanic population relied on

multiple available support persons such family members instead of health care providers to provide advice about weight gain in pregnancy. In a qualitative study examining the knowledge, attitudes and beliefs regarding weight gain during pregnancy among Hispanic women, the participants reported receiving little advice regarding pregnancy weight gain from nutritionists and physicians (Tovar, Chasan-Taber, Bermudez, Hyatt, & Must, 2010). Rather, they frequently mentioned family members, in particular mothers, mothers-in-law, and aunts, as support persons providing specific pregnancy weight gain advice. A major theme emerging from that study was that pregnant women should be eating more because they are eating for two and thereby ensuring a healthier baby. In keeping with that belief, a study by Caballero and Tenzer (2007) reported that Hispanic/ Latino views regarding body image tend to celebrate individuals who are slightly overweight or plump. It is considered a reflection of a state of being well cared for and healthy. This belief system may well have been operant in these findings, although further study including the testing of such a hypothesis would be necessary to determine this.

Association between maternal obesity and infant birthweight.

While nearly half of our sample was overweight or obese, the relationship of pre-pregnancy obesity as a risk factor for delivery of a large for gestational age (LGA) (birth weight over 4000 gms) infant as purported in the literature (Baeten, Bukusi, & Lambe, 2001; Frederick, Williams, Sales, Martin, & Killien, 2008; Nohr et al., 2008) was not borne out by this study's findings. No significant differences in infant birth weight were found between mothers with pre-pregnancy obesity ($BMI \geq 30$) and non- obese mothers. This discrepancy may be explained by several mechanisms. For example, these young women did not have excessive weight gain during their pregnancy, a major contributory risk factor for the delivery of an LGA infant. However, this could not be verified as pregnancy weight gain data were not collected in the

parent study. Another reason for this finding may be the fact that these essentially healthy first time mothers had no co-morbidities, in particular gestational diabetes, which could increase their risk for delivering an infant whose birth weight was greater than 4000 grams. Additionally, the intervention effect of data collection could have impacted these findings. Like the Hawthorne effect, the interaction of the participant and researcher during data collection procedures may alter participant behaviors and responses that result in a more favorable outcome (McCambridge, Witton, & Elbourne, 2014). Finally, the “Latina paradox” in whole or in part may account for this discrepancy (Markides & Coreil, 1986). The Latina epidemiological paradox purports that Latina mothers despite their socioeconomic disadvantages have better birth outcomes compared to populations of mothers with a similar socioeconomic profile. Possible explanations for this paradox, as hypothesized in the empirical and epidemiological literature, include: (1) the healthy migrant theory which posits that the healthiest Latinas immigrate to the United States; (2) protective factors such as a strong cultural support for motherhood, healthy eating practices and devotion to the maternal role; and (3) strong social support networks that act as informal systems of prenatal care which are composed of family, friends and community members (Almeida, Mulready-Ward, Bettgowda, & Ahluwalia, 2014; Flores, Simonsen, Manuck, Dyer, & Turok, 2012; Franzini, Ribble, & Keddie, 2001; Guarini, Marks, Patton, & García Coll, 2015; McGlade, Saha, & Dahlstrom, 2004; Wingate & Alexander, 2006).

In summary, the findings of this dissertation study demonstrate that both childhood maltreatment and pre-pregnancy obesity are significant health issues for these young adult Latina first time mothers. They also have other risk factors such as high perceived stress and lack of a strong social support network which further diminish their already compromised health potential. The association of a maternal history of childhood maltreatment with a 2 fold increase in the risk

for pre-pregnancy obesity is important as we move forward in examining pregnancy and perinatal health risks with respect to psychosocial determinants and correlates.

Strengths of the study

This study has noteworthy strengths. This is the first study to examine maternal history of childhood maltreatment and its risk correlates for pre-pregnancy obesity in a young adult Latina population. In addition, this study explored a more inclusive group of psychosocial risk indices (PTSD, perceived stress and social support) than were examined in two previous studies (Diesel et al., 2014; Hollingsworth et al., 2012). The use of individual structured questionnaires with strong psychometric properties to measure each of the psychosocial variables lends support to the validity and reliability of the findings (Bernstein & Fink, 1998; Cohen et al., 1983; Derogatis, 1977; Sarason et al., 1983; Saunders et al., 1990). Lastly, this was the first study on this topic to employ a theoretical framework, the Life Course Health Development Framework, specifically designed to explore early life experiences (e.g., childhood maltreatment) as factors in the development of later adverse health outcomes (Halfon & Hochstein, 2002).

Limitations of the study

Notable limitations in this study concern methodology and sampling. The study is a cross-sectional assessment of retrospective information. One of the problematic issues in this examination as well as in other research examining the sequelae of childhood maltreatment is that they rely primarily on recall of childhood trauma. This is significant in that it has been argued that traumatic events in childhood are under-reported which may well be due to faulty recall, suppression, report bias and other psychological, developmental and cultural-societal forces (McKinney, Harris, & Caetano, 2009; Widom & Morris, 1997; Williams, 1994). Although the instruments used to collect psychosocial data were valid and reliable, they were

self-report questionnaires and as such, present the problem of shared method variance. Importantly, recall bias is a particular risk. Pre-pregnancy weight and height used to calculate participants' pre-pregnancy BMI was also gathered by self-report estimation and may have been inaccurately recalled by the young women in this study (Krul et al., 2011). Additionally, no information was available regarding the timing or duration of abuse. Furthermore, there was no disclosure regarding treatment interventions or outcomes. There is also no available information regarding other factors in childhood, particularly childhood weight. It is therefore not possible to conclude in this study that the maltreatment preceded obesity or to independently verify information pertaining to the maltreatment provided in the anonymous self-report questionnaire.

Several sampling limitations should be considered when interpreting the results of this study. Non-random convenience sampling was used to recruit participants for the parent study and may therefore threaten generalizability. Of the 204 study participants enrolled in the parent study, only 131 fully completed all components of the study. Those who did fully complete all aspects of the study were not significantly different than 73 who did not. They had higher mean depression scores and a higher number of social support persons available to them. The primarily Hispanic pregnant young women characterized by health disparities, who comprised this study sample may not be representative of the general population of pregnant adolescents. Study participants self-selected into the parent study, presenting the problem of selection bias. This may be directly related to the healthy volunteer effect, in which study participants are more motivated and concerned about their health than those who do not volunteer (Froom, Melamed, Kristal-Boneh, Benbassat & Ribak, 1999). Ederer, Church & Mandel (1993) have also suggested that the healthy volunteer effect can result from specific inclusion and exclusion criteria in the study protocol. This effect may also partially explain the null finding between maternal obesity

and infant birth weight. A healthy pregnancy at time of enrollment was the only pregnancy-related criteria for inclusion in the parent study. Thus, the pregnant adolescents who volunteered for the parent study were healthy with no comorbidities such as diabetes, often associated with the birth of a large for gestational age infant. Lastly, the characteristics of those young adults who did not take part in the study are not known and may be different than those who did participate, perhaps further biasing the findings.

In general and limitations notwithstanding, the study's strengths and potential for moving our knowledge base forward make it valuable as a first, exploratory step in building a body of translational research in this neglected but critically important area. The limitations discussed can be systematically addressed in future projects as we unravel the complex relationship of early maltreatment and other psychosocial risk factors to highly significant health concerns in pregnant and perinatal populations.

Implications and Conclusion

The major findings of this study provide cause for concern and further exploration. These include the fact that young women with a history of MCM were more than twice as likely to have a pre-pregnancy BMI ≥ 30 than those who had not been maltreated. MCM was also significantly associated with depression, PTSD, elevated stress levels and low levels of social support in this pregnant adolescent cohort. Furthermore, almost half the study sample had experienced at least one form of childhood maltreatment and a similar percentage (about forty percent) began their pregnancies as overweight or obese with nearly half of that number in the obese category (pre-pregnancy BMI ≥ 30).

These results confirm that obesity among young childbearing women and early maltreatment remain major public health concerns and are associated in a clinically significant

way. The evidence on both the short and long-term health impact of maternal obesity and childhood maltreatment supports actions directed at controlling maternal obesity and reducing childhood maltreatment. Due to the complex nature of these two associated public health problems, we may need to challenge our assumptions about how to solve these problems. Given these data, it would be prudent to redirect our efforts to earlier time points and processes and not simply attempt to manage the downstream effects of these health issues. We need to closely examine early psychosocial risk factors along the life course such as childhood maltreatment, stress and social support that may impact pregnancy and health outcomes. Targeted interventions based on the knowledge of subgroups at greatest risk would go far in addressing relevant health disparities and help to interrupt the trans-generational repetitive cycle of risk. There are several clinical and policy implications with respect to these concerns.

Clinical practice implications

In 2009, the Institute of Medicine (IOM) released revised guidelines for appropriate pregnancy weight gain based on pre-pregnancy BMI. In 2013, the American College of Obstetricians and Gynecologists (ACOG) issued a committee opinion outlining guidelines for appropriate pregnancy weight and postpartum weight management. However despite these efforts, pre-pregnancy obesity and obesity during pregnancy continue to be major health issues. Studies have demonstrated that there is a lack of consistency among obstetric providers in implementing these guidelines (Boothe-LaRoche, Belay, & Sharma, 2014; Duthie, Drew, & Flynn, 2013; Ferrari & Siega-Riz, 2013). Schmied, Duff, Dahlen, Mills, and Kolt (2011) reported that obstetric health care providers often struggle with how best to talk about or address the subject of being overweight with women recognizing the sensitive and often emotional nature of the subject. This is confirmed in reports from pregnant women who state that their

obstetricians do not offer unsolicited advice about weight related issues but instead offer information in response to patient questions or concerns (Duthie et al., 2013). Given these data, this lack of communication and possible identification of multi-determined risk is a significant gap in current clinical practice. Therefore, it is important to improve communication between obstetric providers and women regarding pregnancy weight guidelines. Practical strategies to address this gap might include: (1) the provision of training workshops for obstetric providers on how to effectively counsel women on healthy weight and lifestyle practices, especially obese childbearing women before, during and after pregnancy; and (2) the development of evidence – based information resources for providers, patients and their families on diet and physical activity during the preconception, prenatal and postpartum periods.

The presence of psychosocial risk factors such as depression, PTSD, stress, lack of social support and a past or current history of abuse and neglect in pregnant women is not uncommon. This study’s findings demonstrate that psychosocial risk, particularly perceived stress, is significantly correlated with a history of maltreatment. This is in keeping with the findings that a history of maltreatment often increases vulnerability to the experience of stress- e.g., the “kindling effect” in trauma (Hankin & Abela, 2005; Post, 1992). The kindling effect refers to the process whereby a person, as a result of vulnerability due to previous trauma, evidences ever increasing and deeper reactivity to stress, grounded in the stress system response through the HPA axis and brain circuitry (LHPA= Limbic HPA system). Therefore, it is important to address an early maltreatment history, which may then predispose women to continuing and more severe levels of stress. Given this critical association between maltreatment and stress, along with its downstream health effects, the implementation of comprehensive, standardized

screening of psychosocial risk indicators in perinatal settings is indicated. In addition, these protocols should address related psychosocial risk indicators as discussed in this study.

However, there is a lack of standardized recommendations in screening for these factors. Furthermore, there is a lack of systematic implementation of these recommendations. The United States Preventive Services Task Force recommends screening pregnant women for depression, tobacco and alcohol use. The American College of Obstetricians and Gynecologists (ACOG) also recommends screening for depression and domestic violence. The American Medical Association endorses screening for domestic violence in prenatal clinics (Harrison & Sidebottom, 2008). Moreover, standardized comprehensive psychosocial risk assessment tools are scarce and generally not used in perinatal settings. The lack of uniform and systematic screening for these risk factors presents an additional missed opportunity for early identification, referral and treatment of these disorders (Harrison & Sidebottom, 2008).

As an example of one solution to this problem, the Prenatal Risk Overview (PRO) is a multi-dimensional tool that was developed by the Minneapolis Health Department to address the need for identification. It screens for psychosocial risk factors that may affect a healthy pregnancy or birth or impede a woman's ability to comply with prenatal care recommendations. The PRO screens for 13 psychosocial risk factors addressing basic needs, social support, interpersonal violence, mental health, substance use, legal problems, and child protection services involvement, and categorizes risk levels as low, moderate, or high. Initial validity and reliability testing of this online screening tool has demonstrated good psychometric properties (Harrison, Godecker, & Sidebottom, 2012a ; Harrison, Godecker, & Sidebottom, 2012b). Use of such an instrument in perinatal treatment settings would allow for standardization in identification, thereby allowing for the implementation of targeted interventions.

Health policy implications

The increased risk of adverse maternal and perinatal outcomes for women who are obese during pregnancy is well established. The time before, during and after pregnancy should be viewed a window of opportunity to minimize these health risks for women and their children at an early stage in their life span. While government organizations like the IOM and programs such as Healthy People 2020 (U.S. Department of Health and Human Services, 2010) have taken action and set measurable objectives to address this national priority, childbearing women especially those characterized by health disparities, still continue to bear a disproportionate burden of obesity and its adverse short and long term health outcomes. Coordinated efforts on the part of federal and local governments as well as community based agencies, businesses and organizations are needed to effectively address this problem. Comprehensive planning to determine local health priorities while leveraging existing assets including community-based organizations and local leaders to develop cost-effective sustainable programs that engage the community may go far to address obesity and its negative effects.

The issue of childhood maltreatment is equally complex requiring a systematic response. To prevent and respond to child abuse and neglect effectively, a common definition of what constitutes child maltreatment would be helpful. Currently there is no single, universally applied definition of child abuse and neglect. Definitions vary within and across groups. For example, legal definitions describing the different forms of child maltreatment for reporting and criminal prosecution purposes are found mainly in State statutes, and definitions vary from state to state. Similarly, agency guidelines for accepting reports, conducting investigations, and providing interventions vary from state to state and sometimes from county to county. In addition, researchers use varying methods to measure and define abuse and neglect, making it difficult to

compare findings across studies. The development of partnerships among various sectors, including health care providers, researchers, legislators and community members can begin to address these variations. Furthermore, public awareness campaigns that raise community consciousness and provide information about available resources and solutions are important initiatives to be considered.

Directions for future research

To date, studies on the association between maltreatment in childhood and pre-pregnancy obesity including this dissertation study have been cross-sectional in nature and involving relatively small clinical samples. Larger population based longitudinal studies are needed to further explicate the complex nature of the relationship between MCM and pre-pregnancy obesity as well as correlated risk factors. As evidence of the urgent need for research in this area, in January of 2015 the National Institute of Nursing Research (NINR) posted a call for nursing research aimed at improving outcomes for women, infants and children through interdisciplinary research focused on maternal nutrition and pre-pregnancy obesity (PA-15-100). Maternal health significantly impacts not only the mother but also the intrauterine environment, and subsequently fetal development and the health of the newborn. An interdisciplinary approach is needed to tackle the complex nature of these relationships. Also, an examination of these relationships through the lens of life course theory will help us to understand factors that may help or hinder the pathway to optimal health and development.

Conclusion

This dissertation study has demonstrated further evidence that childhood maltreatment and pre-pregnancy obesity are significant health priorities that need our attention. It has characterized, for the first time, the high occurrence of both of these health issues in young adult

Latina nulliparas. This study has provided a risk profile of significant psychosocial indices associated with childhood maltreatment and pre-pregnancy obesity. Finally, the study finding that a history of childhood maltreatment more than doubled the risk of pre-pregnancy obesity is clinically meaningful as it imparts the potential for adverse health outcomes for both the mothers and their offspring. Next steps in this critical but neglected area of research are to focus on further clarification of these relationships in larger samples of Latina nulliparas as well as other groups characterized by health disparities.

References

- Aaron, D. J., & Hughes, T. L. (2007). Association of childhood sexual abuse with obesity in a community sample of lesbians. *Obesity*, 15(4), 1023-1028. doi: 10.1038/oby.2007.634
- ACOG Practice Bulletin No. 22: Fetal Macrosomia. (2000). *Obstetrics & Gynecology*, 96(5).
- Almeida, J., Mulready-Ward, C., Bettgowda, V., & Ahluwalia, I. (2014). Racial/Ethnic and Nativity Differences in Birth Outcomes Among Mothers in New York City: The Role of Social Ties and Social Support. *Maternal and Child Health Journal*, 18(1), 90-100. doi:10.1007/s10995-013-1238-5
- Alvarez, J., Pavao, J., Baumrind, N., & Kimerling, R. (2007). The relationship between child abuse and adult obesity among California women. *American Journal of Preventive Medicine*, 33(1), 28-33. doi: 10.1016/j.amepre.2007.02.036
- Amir, L. H., & Donath, S. (2007). A systematic review of maternal obesity and breastfeeding intention, initiation and duration. *BMC Pregnancy and Childbirth*, 7, 9. doi: 10.1186/1471-2393-7-9
- Anda, R., Chapman, D. , Felitti, V. , Edwards, V., Williamson, D., Croft, J., & Giles, W. (2002). Adverse childhood experiences and risk of paternity in teen pregnancy. *Obstetrics and Gynecology*, 100(1), 37-45.
- Anda, R., Croft, J. , Felitti, V. , Nordenberg, D., Giles, W. , Williamson, D. , & Giovino, G. (1999). Adverse childhood experiences and smoking during adolescence and adulthood. *The Journal of the American Medical Association*, 282(17), 1652-1658.

- Anda, R. , Felitti, V. , Bremner, J., Walker, J., Whitfield, C., Perry, B., Dube, S., & Giles, W.(2006). The enduring effects of abuse and related adverse experiences in childhood. A convergence of evidence from neurobiology and epidemiology. *European Archives of Psychiatry and Clinical Neuroscience*, 256(3), 174-186. doi: 10.1007/s00406-005-0624-4
- Anda, R. , Whitfield, C. , Felitti, V. , Chapman, D., Edwards, V., Dube, S., & Williamson, D. (2002). Adverse childhood experiences, alcoholic parents, and later risk of alcoholism and depression. *Psychiatric Services*, 53(8), 1001-1009.
- Baeten, J. M., Bukusi, E. A, & Lambe, M. (2001). Pregnancy complications and outcomes among overweight and obese nulliparous women. *American Journal of Public Health*, 91(3), 436.
- Bell, D., & Belicki, K. (1998). A community-based study of well-being in adults reporting childhood abuse. *Child Abuse & Neglect*, 22(7), 681-685.
- Bennett, D. S., Sullivan, M. W., Thompson, S. M., & Lewis, M. (2010). Early Child Neglect: Does It Predict Obesity or Underweight in Later Childhood? *Child Maltreatment*, 15(3), 250-254. doi: 10.1177/1077559510363730
- Bentley, T., & Widom, C. S. (2009). A 30-year follow-up of the effects of child abuse and neglect on obesity in adulthood. *Obesity*, 17(10), 1900-1905. doi: 10.1038/oby.2009.160
- Bernstein, D. P., Ahluvalia, T., Pogge, D., & Handelsman, L. (1997). Validity of the Childhood Trauma Questionnaire in an adolescent psychiatric population. *Journal of the American Academy of Child and Adolescent Psychiatry*, 36(3), 340-348. doi: 10.1097/00004583-199703000-00012
- Bernstein, D. P., & Fink, L. (1998). *Childhood trauma questionnaire: A retrospective self-report: manual*. San Antonio, Texas: Psychological Corporation.

- Bernstein, D. P., Stein, J. A., Newcomb, M. D., Walker, E., Pogge, D., Ahluvalia, T., Stokes, J., Handelsman, L., Medrano, M., Desmond, D. & Zule, W. (2003). Development and validation of a brief screening version of the Childhood Trauma Questionnaire. *Child Abuse & Neglect*, 27(2), 169-190.
- Bodnar, L. M., Wisner, K. L., Moses-Kolko, E., Sit, D. K., & Hanusa, B. H. (2009). Prepregnancy body mass index, gestational weight gain, and the likelihood of major depressive disorder during pregnancy. *Journal of Clinical Psychiatry*, 70(9), 1290-1296. doi: 10.4088/JCP.08m04651
- Boothe-LaRoche, A., Belay, B., & Sharma, A. K. (2014). Pregnancy and Postpartum Related Weight Counseling Practices of U.S. Obstetrician-Gynecologists: Results from the Doc Styles Survey 2010. *Journal of Women's Health Care*, 3(6), 208-215. doi: 10.4172/2167-0420.1000208
- Boynton-Jarrett, R., Rosenberg, L., Palmer, J. R., Boggs, D. A., & Wise, L. A. (2012). Child and adolescent abuse in relation to obesity in adulthood: the Black Women's Health Study. *Pediatrics*, 130(2), 245-253. doi: 10.1542/peds.2011-1554
- Brick, J., & Kalton, G. (1996). Handling missing data in survey research. *Statistical Methods in Medical Research*, 5(3), 215-238. doi:10.1177/096228029600500302
- Brown, B. E., Garrison, C. J., Anderson, N, L., & Saunders, J. M. (1990). Patterns of Symptomatology of Adult Women Incest Survivors. *Western Journal of Nursing Research*, 12(5), 587-600. doi: 10.1177/019394599001200502

- Brown, J., Cohen, P., Johnson, J. G., & Smailes, E. M. (1999). Childhood Abuse and Neglect: Specificity of Effects on Adolescent and Young Adult Depression and Suicidality. *Journal of the American Academy of Child & Adolescent Psychiatry*, 38(12), 1490-1496. doi: <http://dx.doi.org/10.1097/00004583-199912000-00009>
- Burke, N. J., Hellman, J. L., Scott, B. G., Weems, C. F., & Carrion, V. G. (2011). The impact of adverse childhood experiences on an urban pediatric population. *Child Abuse & Neglect*, 35(6), 408-413. doi: <http://dx.doi.org/10.1016/j.chiabu.2011.02.006>
- Butchart, A., Kahane, T., Phinney, H. , Mian, M. , & Furniss, T. (2006). *Preventing child maltreatment: a guide to taking action and generating evidence*. Geneva: WHO and International Society for the Prevention of Child Abuse and Neglect. Retrieved June 1, 2014 from http://whqlibdoc.who.int/publications/2006/9241594365_eng.pdf
- Caballero, A. E. & Tenzer, P. (2007). Building Cultural Competency for Improved Diabetes Care: Latino Americans and Diabetes. *Journal of Family Practice*, 56, S21-S30.
- Cantril, H. (1965). *The patterns of human concern*. New Brunswick, New Jersey: Rutgers University Press.
- Carlozzi, N. E., & Long, P. J. (2008). Reliability and validity of the SCL-90-R PTSD subscale. *Journal of Interpersonal Violence*, 23(9), 1162-1176. doi: 10.1177/0886260508314295
- Castro, L. C., & Avina, R. L. (2002). Maternal obesity and pregnancy outcomes. *Current Opinion in Obstetrics & Gynecology*, 14(6), 601-606. doi: 10.1097/01.gco.0000045486.15021.C9
- Catalano, P. M., & Ehrenberg, H. M. (2006). The short- and long-term implications of maternal obesity on the mother and her offspring. *BJOG : An International Journal of Obstetrics and Gynaecology*, 113(10), 1126-1133. doi: 10.1111/j.1471-0528.2006.00989.x

- Cederbaum, J. A., Putnam-Hornstein, E., King, B., Gilbert, K., & Needell, B. (2013). Infant birth weight and maltreatment of adolescent mothers. *American Journal of Preventive Medicine*, 45(2), 197-201. doi: 10.1016/j.amepre.2013.03.016
- Cedergren, M. I. (2004). Maternal morbid obesity and the risk of adverse pregnancy outcome. *Obstetrics & Gynecology*, 103(2), 219-224.
- Centers for Disease Control and Prevention. (2009). *About BMI for children and teens*. Retrieved June 1, 2014 , from http://www.cdc.gov/healthy_weight/assessing/bmi/childrens_BMI/about_childrens_BMI.html
- Chapman, D. , Whitfield, C. , Felitti, V., Dube, S., Edwards, V. , & Anda, R. . (2004). Adverse childhood experiences and the risk of depressive disorders in adulthood. *Journal of Affective Disorders*, 82(2), 217-225. doi: 10.1016/j.jad.2003.12.013
- Chartier, M. J., Walker, J. R., & Naimark, B. (2009). Health risk behaviors and mental health problems as mediators of the relationship between childhood abuse and adult health. *American Journal of Public Health*, 99(5), 847-854. doi: 10.2105/AJPH.2007.122408
- Clark, D. B., Thatcher, D. L., & Martin, C. S. (2010). Child abuse and other traumatic experiences, alcohol use disorders, and health problems in adolescence and young adulthood. *Journal of Pediatric Psychology*, 35(5), 499-510. doi: 10.1093/jpepsy/jsp117
- Cohen, S., & Hoberman, H. M. (1983). Positive events and social supports as buffers of life change stress. *Journal of Applied Social Psychology*, 13(2), 99-125. doi: 10.1111/j.1559-1816.1983.tb02325.x
- Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 24(4), 385-396.

- Cohen, S., & Williamson, G. (1988). Perceived stress in a probability sample in the United States. In S. Spacapan & S. Oskamp (Eds.), *The social psychology of health: Claremont symposium on applied social psychology*. Newbury Park, CA: Sage.
- Coker, A. L., Williams, C., Ferguson, J. E., Busch, H. M., Parrish, Y., & Crofford, L. (2008). Intimate or childhood sexual abuse and obesity in Kentucky. *Family Violence Prevention and Health Practice*, 1(7). Retrieved June 1, 2014 from <http://www.futureswithoutviolence.org/health/ejournal/journal-archive/>
- Compas, B. , Slavin, L. , Wagner, B. , & Vannatta, K. (1986). Relationship of life events and social support with psychological dysfunction among adolescents. *Journal of Youth and Adolescence*, 15(3), 205-221.
- D'Argenio, A., Mazzi, C., Pecchioli, L., Di Lorenzo, G., Siracusano, A., & Troisi, A. (2009). Early trauma and adult obesity: Is psychological dysfunction the mediating mechanism? *Physiology & Behavior*, 98(5), 543-546. doi: 10.1016/j.physbeh.2009.08.010
- Danese, A., Caspi, A., Williams, B., Ambler, A., Sugden, K., Mika, J., Werts, H., Freeman, J., Pariante, C., Moffitt, T., & Arseneault, L. (2011). Biological embedding of stress through inflammation processes in childhood. *Molecular Psychiatry*, 16(3), 244-246. doi: 10.1038/mp.2010.5
- Danese, A., & Tan, M. (2014). Childhood maltreatment and obesity: systematic review and meta-analysis. *Molecular Psychiatry*, 19(5), 544-554. doi: 10.1038/mp.2013.54
- Demidenko, E. (2007). Sample size determination for logistic regression revisited. *Statistics in Medicine*, 26(18), 3385-3397. doi: 10.1002/sim.2771
- Derogatis, L. (1977). *SCL-90-R: Administration , scoring and procedures manual*. Balitimore, Maryland: Clinical Psychometric Research.

- Derogatis, L. , Rickels, K., & Rock, A. F. (1976). The SCL-90 and the MMPI: a step in the validation of a new self-report scale. *British Journal of Psychiatry*, 128, 280-289.
- Diesel, J. C., Bodnar, L. M., Day, N. L., & Larkby, C. A. (2014). Childhood maltreatment and the risk of pre-pregnancy obesity and excessive gestational weight gain. *Maternal and Child Nutrition*. doi: 10.1111/mcn.12147
- Dietz, P. M., Callaghan, W. M., Morrow, B., & Cogswell, M. E. (2005). Population-based assessment of the risk of primary cesarean delivery due to excess prepregnancy weight among nulliparous women delivering term infants. *Maternal and Child Health Journal*, 9(3), 237-244. doi: 10.1007/s10995-005-0003-9
- Dong, M., Giles, W. , Felitti, V. , Dube, S. , Williams, J. , Chapman, D. , & Anda, R. (2004). Insights into causal pathways for ischemic heart disease: adverse childhood experiences study. *Circulation*, 110(13), 1761-1766. doi: 10.1161/01.CIR.0000143074.54995.7F
- Dube, S. , Cook, M. , & Edwards, V. (2010). Health-related outcomes of adverse childhood experiences in Texas, 2002. *Preventing Chronic Disease*, 7(3), A52.
- Dube, S. , Felitti, V. , Dong, M., Giles, W. , & Anda, R. (2003). The impact of adverse childhood experiences on health problems: evidence from four birth cohorts dating back to 1900. *Preventive Medicine*, 37(3), 268-277.
- Dube, S. , Felitti, V., Dong, M., Chapman, D. , Giles, W. , & Anda, R. (2003). Childhood abuse, neglect, and household dysfunction and the risk of illicit drug use: the adverse childhood experiences study. *Pediatrics*, 111(3), 564-572.

- Dube, S. , Miller, J. , Brown, D. , Giles, W. , Felitti, V. , Dong, M., & Anda, R. (2006). Adverse childhood experiences and the association with ever using alcohol and initiating alcohol use during adolescence. *The Journal of Adolescent Health*, 38(4), 444 e441-410. doi: 10.1016/j.jadohealth.2005.06.006
- Dube, S., Anda, R. , Felitti, V. , Edwards, V. , & Croft, J. (2002). Adverse childhood experiences and personal alcohol abuse as an adult. *Addictive Behaviors*, 27(5), 713-725.
- Duthie, E., Drew, E., & Flynn, K. (2013). Patient-provider communication about gestational weight gain among nulliparous women: a qualitative study of the views of obstetricians and first-time pregnant women. *BMC Pregnancy Childbirth*, 13(1), 231.
- Ederer, F., Church, T.R., & Mandel, J.S. (1993). Sample sizes for prevention trials have been too small. *American Journal of Epidemiology*, 137(7), 786-796.
- Ehrenberg, H. M., Dierker, L., Milluzzi, C., & Mercer, B. M. (2003). Low maternal weight, failure to thrive in pregnancy, and adverse pregnancy outcomes. *American Journal of Obstetrics and Gynecology*, 189(6), 1726-1730.
- Elliott, G. C., Cunningham, S. M., Linder, M., Colangelo, M., & Gross, M. (2005). Child physical abuse and self-perceived social isolation among adolescents. *Journal of Interpersonal Violence*, 20(12), 1663-1684. doi: 10.1177/0886260505281439
- Felitti, V. (1993). Childhood sexual abuse, depression, and family dysfunction in adult obese patients: a case control study. *Southern Medical Journal*, 86(7), 732-736.
- Felitti, V. (1991). Long-term medical consequences of incest, rape, and molestation. *Southern Medical Journal*, 84(3), 328-331.

- Felitti, V. , Anda, R. , Nordenberg, D., Williamson, D. , Spitz, A. , Edwards, V., Koss, M., & Marks, J. (1998). 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*, 14(4), 245-258.
- Felitti, V., & Anda, R. (Eds.). (2010). *The relationship of adverse childhood experiences to adult medical disease, psychiatric disorders and sexual behavior: implications for healthcare*. New York: Cambridge University Press.
- Ferrari, R. M., & Siega-Riz, A. M. (2013). Provider advice about pregnancy weight gain and adequacy of weight gain. *Maternal and Child Health Journal*, 17(2), 256-264. doi: 10.1007/s10995-012-0969-z
- Fine, A., & Kotelchuck, M. (2010). *Rethinking MCH: the Life Course Model as an Organizing Framework*.: US Department of Health and Human Services, Health Resources and Services Administration. Retrieved June 1, 2014 from <http://mchb.hrsa.gov/lifecourse/rethinkingmchlifecourse.pdf>.
- Flegal, K. M., Carroll, M. D., Ogden, C. L., & Curtin, L. R. (2010). Prevalence and trends in obesity among US adults, 1999-2008. *The Journal of the American Medical Association*, 303(3), 235-241. doi: 10.1001/jama.2009.2014
- Flores, M. E., Simonsen, S. E., Manuck, T. A., Dyer, J. M., & Turok, D. K. (2012). The "Latina epidemiologic paradox": contrasting patterns of adverse birth outcomes in U.S.-born and foreign-born Latinas. *Womens Health Issues*, 22(5), e501-507. doi:10.1016/j.whi.2012.07.005
- Franzini, L., Ribble, J. C., & Keddie, A. M. (2001). *Understanding the Hispanic paradox*. *Ethnicity & Disease*, 11(3), 496-518.

- Frederick, I. O., Williams, M A., Sales, A E., Martin, D. P., & Killien, M. (2008). Pre-pregnancy body mass index, gestational weight gain, and other maternal characteristics in relation to infant birth weight. *Maternal and Child Health Journal*, 12(5), 557-567.
- Froom, P., Melamed, S., Kristal-Boneh, E., Benbassat, J., & Ribak, J. (1999). "Healthy volunteer effect in industrial workers." *Journal of Clinical Epidemiology* 52(8): 731-735.
- Fryar, C., Carroll, M., & Ogden, C. (2014). Prevalence of Overweight and Obesity among Children and Adolescents: United States, 1963-1965 Through 2011-2012. NCHS Health E-Stat. Retrieved June 3, 2015 from http://www.cdc.gov/nchs/data/hestat/obesity_child_11_12/obesity_child_11_12.htm
- Fuemmeler, B. F., Dedert, E., McClernon, F. J., & Beckham, J. C. (2009). Adverse childhood events are associated with obesity and disordered eating: results from a U.S. population-based survey of young adults. *Journal of Traumatic Stress*, 22(4), 329-333. doi: 10.1002/jts.20421
- Gabbe, S. G., & Graves, C. R. (2003). Management of diabetes mellitus complicating pregnancy. *Obstetrics and Gynecology*, 102(4), 857-868.
- Gavin, A. R., Hill, K. G., Hawkins, J. D., & Maas, C. (2011). The role of maternal early-life and later-life risk factors on offspring low birth weight: findings from a three-generational study. *The Journal of Adolescent Health* 49(2), 166-171. doi: 10.1016/j.jadohealth.2010.11.246
- Gavin, A. R., Thompson, E., Rue, T., & Guo, Y. (2012). Maternal early life risk factors for offspring birth weight: findings from the Add Health Study. *Prevention Science* 13(2), 162-172. doi: 10.1007/s11121-011-0253-2

- Gracia, E., & Musitu, G. (2003). Social isolation from communities and child maltreatment: a cross-cultural comparison. *Child Abuse and Neglect*, 27(2), 153-168.
- Greenfield, E. A., & Marks, N. F. (2009). Violence from parents in childhood and obesity in adulthood: using food in response to stress as a mediator of risk. *Social Science & Medicine*, 68(5), 791-798. doi: 10.1016/j.socscimed.2008.12.004
- Groveman, SA. (2008). New preterm infant growth curves influence of gender and race on birth Size. (Master's Thesis), Drexel University, Philadelphia, PA.
- Guarini, T., Marks, A., Patton, F., & García Coll, C. (2015). The Immigrant Paradox in Pregnancy: Explaining the First-Generation Advantage for Latina Adolescents. *Journal of Research on Adolescence*, 25(1), 14-19. doi:10.1111/jora.12096
- Guelinckx, I., Devlieger, R., Beckers, K., & Vansant, G. (2008). Maternal obesity: pregnancy complications, gestational weight gain and nutrition. *Obesity Reviews* 9(2), 140-150. doi: 10.1111/j.1467-789X.2007.00464.x
- Gunstad, J., Paul, R.H., Spitznagel, M.B., Cohen, R.A., Williams, L.M., Kohn, M., & Gordon, E. (2006). Exposure to early life trauma is associated with adult obesity. *Psychiatry Research*, 142(1), 31-37.
- Halfon, N., & Hochstein, M. (2002). Life course health development: an integrated framework for developing health, policy, and research. *Milbank Quarterly*, 80(3), 433-479.
- Han, Y. S., Ha, E. H., Park, H. S., Kim, Y. J., & Lee, S. S. (2011). Relationships between pregnancy outcomes, biochemical markers and pre-pregnancy body mass index. *International Journal of Obesity* 35(4), 570-577. doi: 10.1038/ijo.2010.162
- Hankin, B. L., & Abela, J. (2005). *Development of psychopathology: A vulnerability-stress perspective*: Sage Publications.

- Harkness, K. L., Bagby, R. M., & Kennedy, S. H. (2012). Childhood maltreatment and differential treatment response and recurrence in adult major depressive disorder. *Journal of Consulting & Clinical Psychology*, 80(3), 342-353. doi: 10.1037/a0027665
- Harrison, P. A., Godecker, A., & Sidebottom, A. (2012a). Validity of the prenatal risk overview for detecting drug use disorders in pregnancy. *Public Health Nursing*, 29(6), 563-573. doi: 10.1111/j.1525-1446.2012.01030.x
- Harrison, P. A., Godecker, A., & Sidebottom, A. C. (2012b) Validation of the alcohol use module from a multidimensional prenatal psychosocial risk screening instrument. *Maternal and Child Health Journal*, 16(9), 1791-1800. doi: 10.1007/s10995-011-0926-2
- Harrison, P., & Sidebottom, A.C. (2008). Systematic prenatal screening for psychosocial risks. *Journal of Health Care for the Poor and Underserved*, 19(1), 258-276.
- Heim, C., Newport, D. J., Bonsall, R., Miller, A. H., & Nemeroff, C. B. (2001). Altered pituitary-adrenal axis responses to provocative challenge tests in adult survivors of childhood abuse. *American Journal of Psychiatry*, 158(4), 575-581.
- Helgstrand, S., & Andersen, A. M. (2005). Maternal underweight and the risk of spontaneous abortion. *Acta Obstetrica et Gynecologica Scandinavica*, 84(12), 1197-1201. doi: 10.1111/j.0001-6349.2005.00706.x
- Hemmingsson, E., Johansson, K., & Reynisdottir, S. (2014). Effects of childhood abuse on adult obesity: a systematic review and meta-analysis. *Obesity Reviews*. doi: 10.1111/obr.12216

- Hepgul, N., Pariante, C. M., Dipasquale, S., DiForti, M., Taylor, H., Marques, T. R., Morgan, C., Dazzan, P., Murray, R., & Mondelli, V. (2012). Childhood maltreatment is associated with increased body mass index and increased C-reactive protein levels in first-episode psychosis patients. *Psychological Medicine*, 42(09), 1893-1901. doi: doi:10.1017/S0033291711002947
- Higgins, D. J., & McCabe, M. P. (2000). Multi-type maltreatment and the long-term adjustment of adults. *Child Abuse Review*, 9(1), 6-18. doi: 10.1002/(SICI)1099-0852(200001/02)9:1<6::AID-CAR579>3.0.CO;2-W
- Hillis, S. D., Anda, R. F., Dube, S. R., Felitti, V. J., Marchbanks, P. A., & Marks, J. S. (2004). The association between adverse childhood experiences and adolescent pregnancy, long-term psychosocial consequences, and fetal death. *Pediatrics*, 113(2), 320-327.
- Hillis, S. D., Anda, R. F., Felitti, V. J., Nordenberg, D., & Marchbanks, P. A. (2000). Adverse childhood experiences and sexually transmitted diseases in men and women: a retrospective study. *Pediatrics*, 106(1), E11.
- Hollingsworth, K., Callaway, L., Duhig, M., Matheson, S., & Scott, J. (2012). The association between maltreatment in childhood and pre-pregnancy obesity in women attending an antenatal clinic in Australia. *PLOS ONE* 7(12), e51868. doi: 10.1371/journal.pone.0051868
- Holmberg, L. I., & Hellberg, D. (2010). Sexually abused children. Characterization of these girls when adolescents. *International Journal of Adolescent Medicine and Health*, 22(2), 291-300.
- Hosmer, D., & Lemeshow, S. (2004). *Applied logistic regression*. New Jersey: John Wiley & Sons.

- Hussey, J. M., Chang, J. J., & Kotch, J. B. (2006). Child Maltreatment in the United States: Prevalence, Risk Factors, and Adolescent Health Consequences. *Pediatrics*, 118(3), 933-942. doi: 10.1542/peds.2005-2452
- Hyman, S. M., Paliwal, P., & Sinha, R. (2007). Childhood maltreatment, perceived stress, and stress-related coping in recently abstinent cocaine dependent adults. *Psychology of Addictive Behaviors*, 21(2), 233-238. doi: 10.1037/0893-164X.21.2.233
- Jeric, M., Roje, D., Medic, N., Strinic, T., Mestrovic, Z., & Vulic, M. (2013). Maternal pre-pregnancy underweight and fetal growth in relation to Institute of Medicine recommendations for gestational weight gain. *Early Human Development*, 89(5), 277-281. doi: 10.1016/j.earlhumdev.2012.10.004
- Jia, H., Li, J. Z., Leserman, J., Hu, Y., & Drossman, D. A. (2004). Relationship of abuse history and other risk factors with obesity among female gastrointestinal patients. *Digestive Diseases and Sciences*, 49(5), 872-877.
- Johnson, J. , Cohen, P., Kasen, S., & Brook, J. (2002). Childhood adversities associated with risk for eating disorders or weight problems during adolescence or early adulthood. *The American Journal of Psychiatry*, 159(3), 394-400.
- Kearney, J.K. & Byrne, M. W. (2013) Unpublished manuscript.
- Knutson, J. F., DeGarmo, D. S., Koepl, G., & Reid, J. B. (2005). Care neglect, supervisory neglect, and harsh parenting in the development of children's aggression: A replication and extension. *Child Maltreatment*, 10(2), 92-107. doi: 10.1177/1077559504273684
- Knutson, J. F., DeGarmo, D. S., & Reid, J. B. (2004). Social disadvantage and neglectful parenting as precursors to the development of antisocial and aggressive child behavior: Testing a theoretical model. *Aggressive Behavior*, 30(3), 187-205. doi: 10.1002/ab.20016

- Knutson, J. F., Taber, S. M., Murray, A. J., Valles, N. L., & Koepl, G. (2010). The role of care neglect and supervisory neglect in childhood obesity in a disadvantaged sample. *Journal of Pediatric Psychology, 35*(5), 523-532. doi: 10.1093/jpepsy/jsp115
- Krul, A. J., Daanen, H. A., & Choi, H. (2011). Self-reported and measured weight, height and body mass index (BMI) in Italy, the Netherlands and North America. *The European Journal of Public Health, 21*(4), 414-419. doi: 10.1093/eurpub/ckp228
- Kuo, S. Y., Chen, S. R., & Tzeng, Y. L. (2014). Depression and anxiety trajectories among women who undergo an elective cesarean section. *PLOS ONE, 9*(1), e86653. doi: 10.1371/journal.pone.0086653
- Lacoursiere, D. Y., Baksh, L., Bloebaum, L., & Varner, M. W. (2006). Maternal body mass index and self-reported postpartum depressive symptoms. *Maternal Child Health Journal, 10*(4), 385-390. doi: 10.1007/s10995-006-0075-1
- Lanius, R., Vermetten, E., & Pain, C. Eds. (2010). *The impact of early life trauma on health and disease : the hidden epidemic*. New York: Cambridge University Press.
- Laraia, B. A., Siega-Riz, A. M., Dole, N., & London, E. (2009). Pregravid weight is associated with prior dietary restraint and psychosocial factors during pregnancy. *Obesity, 17*(3), 550-558. doi: 10.1038/oby.2008.585
- Leddy, M. A., Power, M. L., & Schulkin, J. (2008). The Impact of Maternal Obesity on Maternal and Fetal Health. *Reviews in Obstetrics and Gynecology, 1*(4), 170-178.
- Lehman, B. J., Taylor, S. E., Kiefe, C. I., & Seeman, T. E. (2005). Relation of childhood socioeconomic status and family environment to adult metabolic functioning in the CARDIA Study. *Psychosomatic Medicine, 67*(6), 846-854.

- Lissau, I., & Sorensen, T. I. (1994). Parental neglect during childhood and increased risk of obesity in young adulthood. *Lancet*, 343(8893), 324-327.
- Maconochie, N., Doyle, P., Prior, S., & Simmons, R. (2007). Risk factors for first trimester miscarriage--results from a UK-population-based case-control study. *BJOG : An International Journal of Obstetrics and Gynaecology*, 114(2), 170-186. doi: 10.1111/j.1471-0528.2006.01195.x
- Mamun, A. A., Lawlor, D. A., O'Callaghan, M. J., Bor, W., Williams, G. M., & Najman, J. M. (2007). Does childhood sexual abuse predict young adult's ? A birth cohort study. *Obesity*, 15(8), 2103-2110. doi: 10.1038/oby.2007.250
- Markides, K. S., & Coreil, J. (1986). The health of Hispanics in the southwestern United States: an epidemiologic paradox. *Public Health Reports*, 101(3), 253-265.
- Martyn-Nemeth, P. A., & Penckofer, S. (2012). Psychological vulnerability among overweight/obese minority adolescents. *The Journal of School Nursing*, 28(4), 291-301. doi: 10.1177/1059840511430508
- McCambridge, J., Witton, J., & Elbourne, D. R. (2014). Systematic review of the Hawthorne effect: new concepts are needed to study research participation effects. *Journal of Clinical Epidemiology*, 67(3), 267-277. doi:10.1016/j.jclinepi.2013.08.015
- McEwen, B. S. (1998). Protective and damaging effects of stress mediators. *New England Journal of Medicine*, 338(3), 171-179. doi: 10.1056/NEJM199801153380307
- McGlade, M. S., Saha, S., & Dahlstrom, M. E. (2004). The Latina paradox: an opportunity for restructuring prenatal care delivery. *American Journal of Public Health*, 94(12), 2062-2065.

- Mesman, I., Roseboom, T. J., Bonsel, G. J., Gemke, R. J., van der Wal, M. F., & Vrijkotte, T. G. (2009). Maternal pre-pregnancy body mass index explains infant's weight and BMI at 14 months: results from a multi-ethnic birth cohort study. *Archives of Disease in Childhood*, 94(8), 587-595. doi: 10.1136/adc.2008.137737
- Midei, A. J., Matthews, K. A., & Bromberger, J. T. (2010). Childhood abuse is associated with adiposity in midlife women: possible pathways through trait anger and reproductive hormones. *Psychosomatic Medicine*, 72(2), 215-223. doi: 10.1097/PSY.0b013e3181cb5c24
- Min, M. O., Minnes, S., Kim, H., & Singer, L. T. (2013). Pathways linking childhood maltreatment and adult physical health. *Child Abuse & Neglect*, 37(6), 361-373. doi: <http://dx.doi.org/10.1016/j.chiabu.2012.09.008>
- Moeller, T. P., Bachmann, G. A., & Moeller, J. R. (1993). The combined effects of physical, sexual, and emotional abuse during childhood: Long-term health consequences for women. *Child Abuse & Neglect*, 17(5), 623-640. doi: [http://dx.doi.org/10.1016/0145-2134\(93\)90084-I](http://dx.doi.org/10.1016/0145-2134(93)90084-I)
- Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Medicine*, 6(6): e1000097, doi:10.1371/journal.pmed1000097
- Moyer, D. M., DiPietro, L., Berkowitz, R. I., & Stunkard, A.J. (1997). Childhood sexual abuse and precursors of binge eating in an adolescent female population. *International Journal of Eating Disorders*, 21(1), 23-30. doi: 10.1002/(sici)1098-108x(199701)21:1<23::aid-eat3>3.0.co;2-5

- Nanni, V., Uher, R., & Danese, A. (2012). Childhood maltreatment predicts unfavorable course of illness and treatment outcome in depression: a meta-analysis. *American Journal of Psychiatry*, 169(2), 141-151.
- Nohr, E.A., Vaeth, M., Baker, J.L., Sorensen, T.I., Olsen, J., & Rasmussen, K.M. (2008). Combined associations of prepregnancy body mass index and gestational weight gain with the outcome of pregnancy. *The American Journal of Clinical Nutrition*, 87(6), 1750-1759.
- Noll, J. G., Zeller, M. H., Trickett, P. K., & Putnam, F. W. (2007). Obesity Risk for Female Victims of Childhood Sexual Abuse: A Prospective Study. *Pediatrics*, 120(1), e61-e67. doi: 10.1542/peds.2006-3058
- Nooner, K. B., Linares, L. O., Batinjane, J., Kramer, R. A., Silva, R., & Cloitre, M. (2012). Factors related to posttraumatic stress disorder in adolescence. *Trauma Violence Abuse*, 13(3), 153-166. doi: 10.1177/1524838012447698
- O'Brien, T. E., Ray, J. G., & Chan, W. S. (2003). Maternal body mass index and the risk of preeclampsia: a systematic overview. *Epidemiology*, 14(3), 368-374.
- Olsen, I. E., Groveman, S. A., Lawson, M. L., Clark, R. H., & Zemel, B. S. (2010). New intrauterine growth curves based on United States data. *Pediatrics*, 125(2), e214-224. doi: 10.1542/peds.2009-0913
- Pederson, C. L., & Wilson, J. F. (2009). Childhood emotional neglect related to posttraumatic stress disorder symptoms and body mass index in adult women. *Psychological Reports*, 105(1), 111-126.
- Pine, D. S. (2003). Developmental psychobiology and response to threats: relevance to trauma in children and adolescents. *Biological Psychiatry*, 53(9), 796-808.

- Pinhas-Hamiel, O., Modan-Moses, D., Herman-Raz, M., & Reichman, B. (2009). Obesity in girls and penetrative sexual abuse in childhood. *Acta Paediatrica*, 98(1), 144-147. doi: 10.1111/j.1651-2227.2008.01044.x
- Post, R.M. (1992). Transduction of psychosocial stress into the neurobiology. *American Journal of Psychiatry*, 149, 999-1010.
- Rasmussen, K. M., & Yaktine, A. L. (Eds.). (2009). Institute of Medicine (Committee to Reexamine IOM Pregnancy Weight Guidelines, Food and Nutrition Board and Board on Children, Youth, and Families) *Weight Gain During Pregnancy: Reexamining the Guidelines*. Washington, D.C.: National Academy Press.
- Rich-Edwards, J. W., Spiegelman, D., Hibert, E. L., Jun, H-J., Todd, T. J., Kawachi, I., & Wright, R. J. (2010). Abuse in Childhood and Adolescence As a Predictor of Type 2 Diabetes in Adult Women. *American Journal of Preventive Medicine*, 39(6), 529-536. doi: <http://dx.doi.org/10.1016/j.amepre.2010.09.007>
- Rodgers, C. S., Lang, A. J., Laffaye, C., Satz, L. E., Dresselhaus, T. R., & Stein, M. B. (2004). The impact of individual forms of childhood maltreatment on health behavior. *Child Abuse & Neglect*, 28(5), 575-586. doi: <http://dx.doi.org/10.1016/j.chiabu.2004.01.002>
- Roeholt, S., Beck, N. N., Karsberg, S. H., & Elklit, A. (2012). Post-traumatic stress symptoms and childhood abuse categories in a national representative sample for a specific age group: associations to body mass index. *European Journal of Psychotraumatology*, 3. doi: 10.3402/ejpt.v3i0.17188

- Rohde, P., Ichikawa, L., Simon, G. E., Ludman, E. J., Linde, J. A., Jeffery, R. W., & Operskalski, B. H. (2008). Associations of child sexual and physical abuse with obesity and depression in middle-aged women. *Child Abuse & Neglect*, 32(9), 878-887. doi: 10.1016/j.chiabu.2007.11.004
- Rosenberg, T. J., Garbers, S., Chavkin, W., & Chiasson, M. A. (2003). Prepregnancy weight and adverse perinatal outcomes in an ethnically diverse population. *Obstetrics and Gynecology*, 102(5 Pt 1), 1022-1027.
- Sarason, I. G., Levine, H, Basham, R., & Sarason, B. R. (1983). Assessing social support: The Social Support Questionnaire. *Journal of Personality and Social Psychology*, 44(1), 127-139.
- Sarason, I. G., Sarason, B.R., Shearin, E.N., & Pierce, G. R. (1987). A brief measure of social support: Practical and theoretical implications. *Journal of Social and Personal Relationships*, 4(4), 497-510. doi: 10.1177/0265407587044007
- Saunders, B. E., Arata, C.M., & Kilpatrick, D. G. (1990). Development of a crime-related Post-traumatic stress disorder scale for women within the Symptom Checklist-90-Revised. *Journal of Traumatic Stress*, 3(3), 439-448.
- Schmied, V. A., Duff, M., Dahlen, H. G., Mills, A. E., & Kolt, G. S. (2011). 'Not waving but drowning': a study of the experiences and concerns of midwives and other health professionals caring for obese childbearing women. *Midwifery*, 27(4), 424-430. doi: <http://dx.doi.org/10.1016/j.midw.2010.02.010>
- Schneiderman, J. U., Mennen, F. E., Negriff, S., & Trickett, P. K. (2012). Overweight and obesity among maltreated young adolescents. *Child Abuse & Neglect*, 36(4), 370-378. doi: 10.1016/j.chiabu.2012.03.001

- Schumm, J. A., Stines, L. R., Hobfoll, S. E., & Jackson, A. P. (2005). The double-barreled burden of child abuse and current stressful circumstances on adult women: The kindling effect of early traumatic experience. *Journal of Traumatic Stress, 18*(5), 467-476. doi: 10.1002/jts.20054
- Schur, E., Godfrey, K. M., Dansie, E., Buchwald, D., Pagoto, S., & Afari, N. (2013). Can familial factors account for the association of body mass index with poor mental health in men or women? *General Hospital Psychiatry, 35*(5), 502-507. doi: 10.1016/j.genhosppsy.2013.04.004
- Seng, J. S., Low, L. K., Sperlich, M., Ronis, D. L., & Liberzon, I. (2009). Prevalence, Trauma History, and Risk for Posttraumatic Stress Disorder Among Nulliparous Women in Maternity Care. *Obstetrics & Gynecology, 114*(4), 839-847.
- Seng, J. S., Low, L. K., Sperlich, M., Ronis, D. L., & Liberzon, I. (2011). Post-traumatic stress disorder, child abuse history, birthweight and gestational age: a prospective cohort study. *BJOG: An International Journal of Obstetrics & Gynaecology, 118*(11), 1329-1339. doi: 10.1111/j.1471-0528.2011.03071.x
- Sesar, K., Simic, N., & Barisic, M. (2010). Multi-type childhood abuse, strategies of coping, and psychological adaptations in young adults. *Croatian Medical Journal, 51*(5), 406-416.
- Shiffman, S., Stone, A., & Hufford, R. (2008). Ecological Momentary Assessment. *Annual Review of Clinical Psychology, 4*(1), 1-32. doi:10.1146/annurev.clinpsy.3.022806.091415
- Shin, S.H., & Miller, D. P. (2012). A longitudinal examination of childhood maltreatment and adolescent obesity: Results from the National Longitudinal Study of Adolescent Health (AddHealth) Study. *Child Abuse & Neglect, 36*(2), 84-94.

- Sickel, A.E., Noll, J.G., Moore, P. J., Putnam, F. W., & Trickett, P. K. (2002). The Long-term Physical Health and Healthcare Utilization of Women Who Were Sexually Abused as Children. *Journal of Health Psychology, 7*(5), 583-597.
doi: 10.1177/1359105302007005677
- Siega-Riz, A.M., Viswanathan, M., Moos, M.K., Deierlein, A., Mumford, S., Knaack, J., Thieda, P., Lux, L.J., & Lohr, K.N. (2009). A systematic review of outcomes of maternal weight gain according to the Institute of Medicine recommendations: birthweight, fetal growth, and postpartum weight retention. *American Journal of Obstetrics and Gynecology, 201*(4), 339. e331-339. e314.
- Singh, G. K., Siahpush, M., Hiatt, R. A., & Timsina, L. R. (2011). Dramatic increases in obesity and overweight prevalence and body mass index among ethnic-immigrant and social class groups in the United States, 1976-2008. *Journal of Community Health, 36*(1), 94-110. doi: 10.1007/s10900-010-9287-9
- Smith, H. A., Markovic, N., Danielson, M. E., Matthews, A., Youk, A., Talbott, E. O., Larkby, C., & Hughes, T. (2010). Sexual Abuse, Sexual Orientation, and Obesity in Women. *Journal of Women's Health, 19*(8), 1525-1532. doi: 10.1089/jwh.2009.1763
- Smith, S. A., Hulsey, T., & Goodnight, W. (2008). Effects of obesity on pregnancy. *Journal of Obstetric, Gynecologic, and Neonatal Nursing, 37*(2), 176-184. doi: 10.1111/j.1552-6909.2008.00222.x
- Sperry, D. M., & Widom, C.S. (2013). Child abuse and neglect, social support, and psychopathology in adulthood: A prospective investigation. *Child Abuse & Neglect, 37*(6), 415-425. doi: <http://dx.doi.org/10.1016/j.chiabu.2013.02.006>

- Springs, F. E., & Friedrich, W. N. (1992). Health risk behaviors and medical sequelae of childhood sexual abuse. *Mayo Clinic Proceedings*, 67(6), 527-532.
- Stengel, M. R., Kraschnewski, J. L., Hwang, S. W., Kjerulff, K. H., & Chuang, C. H. (2012). "What my doctor didn't tell me": examining health care provider advice to overweight and obese pregnant women on gestational weight gain and physical activity. *Womens Health Issues*, 22(6), e535-540. doi: 10.1016/j.whi.2012.09.004
- Stevens-Simon, C., & McAnarney, E. R. (1994). Childhood victimization: relationship to adolescent pregnancy outcome. *Child Abuse & Neglect*, 18(7), 569-575.
- Stotland, N. E., Cheng, Y. W., Hopkins, L. M., & Caughey, A. B. (2006). Gestational weight gain and adverse neonatal outcome among term infants. *Obstetrics and Gynecology*, 108(3 Pt 1), 635-643. doi: 10.1097/01.AOG.0000228960.16678.bd
- Thomas, C., Hypponen, E., & Power, C. (2008). Obesity and type 2 diabetes risk in midadult life: The role of childhood adversity. *Pediatrics*, 121(5), e1240-1249. doi: 10.1542/peds.2007-2403
- Torres, S. J., & Nowson, C. A. (2007). Relationship between stress, eating behavior, and obesity. *Nutrition*, 23(11-12), 887-894. doi: 10.1016/j.nut.2007.08.008
- Tovar, A., Chasan-Taber, L., Bermudez, O. I., Hyatt, R. R., & Must, A. (2010). Knowledge, attitudes, and beliefs regarding weight gain during pregnancy among Hispanic women. *Maternal and Child Health Journal*, 14(6), 938-949. doi: 10.1007/s10995-009-0524-8

- U.S. Department of Health and Human Services, Administration for Children and Families, Administration on Children, Youth and Families, Children's Bureau. (2013). Child Maltreatment 2012. Retrieved June 1, 2014 from <http://www.acf.hhs.gov/programs/cb/research-data-technology/statistics-research/child-maltreatment>.
- U.S. Department of Health and Human Services. Office of Disease Prevention and Health Promotion (2010). Healthy People 2020. Washington, DC. Retrieved June 1, 2014 from <http://www.healthypeople.gov/2020/topicsobjectives2020/default.asp>
- van Reedt Dortland, A. K., Giltay, E. J., van Veen, T., Zitman, F. G., & Penninx, B. W. (2012). Personality traits and childhood trauma as correlates of metabolic risk factors: The Netherlands Study of Depression and Anxiety (NESDA). *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 36(1), 85-91. doi: <http://dx.doi.org/10.1016/j.pnpbp.2011.10.001>
- Vasudevan, C., Renfrew, M., & McGuire, W. (2011). Fetal and perinatal consequences of maternal obesity. *Archives of Disease in Childhood*, 96(5), F378-382. doi: 10.1136/adc.2009.170928
- Vesco, K. K., Dietz, P. M., Rizzo, J., Stevens, V. J., Perrin, N. A., Bachman, D. J., Callaghan, W.M., Bruce, F.C., & Hornbrook, M. C. (2009). Excessive gestational weight gain and postpartum weight retention among obese women. *Obstetrics and Gynecology*, 114(5), 1069-1075. doi: 10.1097/AOG.0b013e3181baeacf
- Vranceanu, A. M., Hobfoll, S. E., & Johnson, R. J. (2007). Child multi-type maltreatment and associated depression and PTSD symptoms: the role of social support and stress. *Child Abuse & Neglect*, 31(1), 71-84. doi: 10.1016/j.chiabu.2006.04.010

- Walker, E. A., Gelfand, A., Katon, W. J., Koss, M. P., Von Korff, M., Bernstein, D., & Russo, J. (1999). Adult health status of women with histories of childhood abuse and neglect. *The American Journal of Medicine*, 107(4), 332-339.
- Walker, E. A., Unutzer, J., Rutter, C., Gelfand, A., Saunders, K., VonKorff, M., Koss, M., & Katon, W. (1999). Costs of health care use by women HMO members with a history of childhood abuse and neglect. *Archives of General Psychiatry*, 56(7), 609-613. doi: 10.1001/archpsyc.56.7.609
- Wenze, S. J., & Miller, I. W. (2010). Use of ecological momentary assessment in mood disorders research. *Clinical Psychology Review*, 30(6), 794-804.
- Whitaker, R. C. (2004). Predicting Preschooler Obesity at Birth: The Role of Maternal Obesity in Early Pregnancy. *Pediatrics*, 114(1), e29-e36. doi: 10.1542/peds.114.1.e29
- Whitaker, R. C., Phillips, S. M., Orzol, S. M., & Burdette, H. L. (2007). The association between maltreatment and obesity among preschool children. *Child Abuse & Neglect*, 31(11-12), 1187-1199. doi: 10.1016/j.chiabu.2007.04.008
- Widom, C. S., DuMont, K., & Czaja, S. J. (2007). A prospective investigation of major depressive disorder and comorbidity in abused and neglected children grown up. *Archives of General Psychiatry*, 64(1), 49-56. doi: 10.1001/archpsyc.64.1.49
- Widom, C. S. (1999). Posttraumatic stress disorder in abused and neglected children grown up. *American Journal of Psychiatry*, 156(8), 1223-1229.
- Widom, C. S., & Morris, S. (1997). Accuracy of adult recollections of childhood victimization, Part 2: Childhood sexual abuse. *Psychological Assessment*, 9(1), 34-46. doi: 10.1037/1040-3590.9.1.34

- Wingate, M. S., & Alexander, G. R. (2006). The healthy migrant theory: variations in pregnancy outcomes among US-born migrants. *Social Science and Medicine*, 62(2), 491-498.
doi:10.1016/j.socscimed.2005.06.015
- Williams, L.M. (1994). Recall of childhood trauma: A prospective study of women's memories of child sexual abuse. *Journal of Consulting and Clinical Psychology* 62(6), 1167-1176.
doi: 10.1037/0022-006X.62.6.1167
- Williamson, D. F., Thompson, T. J., Anda, R. F., Dietz, W. H., & Felitti, V. (2002). Body weight and obesity in adults and self-reported abuse in childhood. *International Journal of Obesity* 26(8), 1075-1082. doi: 10.1038/sj.ijo.0802038
- Yogev, Y., & Catalano, P. M. (2009). Pregnancy and obesity. *Obstetrics & Gynecology Clinics of North America*, 36(2), 285-300, viii. doi: 10.1016/j.ogc.2009.03.003
- Yu, Z., Han, S., Zhu, J., Sun, X., Ji, C., & Guo, X. (2013). Pre-pregnancy body mass index in relation to infant birth weight and offspring overweight/obesity: a systematic review and meta-analysis. *PLOS One*, 8(4), e61627.
- Zuckerman, M., & Lubin, B. (1965). *Manual for the Multiple Affect Adjective Check List*. San Diego, California: Educational and Industrial Testing Service.

Appendices

Appendix A

Parent study protocol schedule

	Weeks of Pregnancy							
	13-16 weeks	24-27 weeks	28 weeks	30-31 weeks	34 weeks	34-37 weeks	36-38 weeks	Birth
ABP Sessions	✓	✓				✓		
Blood Collection sessions			✓		✓			
Fetal Sessions				✓			✓	
Newborn sessions								✓

ABP: Ambulatory blood pressure

Appendix B

Physiological measures and collection procedures

Description of specific measures and collection procedures

Maternal blood pressure, heart rate and respiration. At the start of each ambulatory blood pressure (ABP) monitoring session, the participant was fitted with an ambulatory blood pressure monitor. The monitor recorded the participant's blood pressure every 30 minutes and her heart rate continuously over a 24-hour period. ABP monitoring was repeated on a second day to increase reliability. Participants who enrolled in their second trimester of pregnancy underwent only 2 ABP sessions.

During the fetal sessions, maternal blood pressure, heart rate and respiration were assessed during exposure to a cognitive challenge. The participant's heart rate and respiration was monitored using three standard electrodes placed on the participant's chest. Blood pressure was assessed through a small cuff wrapped around the participant's middle finger. In addition, the participant was instructed to perform a task on the computer, the Stroop color word-matching task. After 5 minutes of baseline, the participant completed a 5-minute Stroop color word task followed by a 5-minute recovery period. The participant then completed a breathing exercise for 6 minutes, followed by a 10-minute recovery period. During the breathing task, the participant increased or decreased her breathing rate as directed by a moving bar on the computer screen. The participant was instructed to increase her breathing rate to 30 breaths per minute and decrease her breathing rate to 10 breaths per minute. The participant was then asked to rate the stress she experienced on a 1 (none at all) to 10 (extreme stress) scale after each period. The session took approximately 31 minutes.

Ecological momentary assessment (EMA) of current maternal mood state.

Ecological momentary assessment is the repeated sampling of participants' current behaviors and experiences while they are engaged in their day-to-day routines in their natural environment. It employs technologies ranging from written diaries and telephones to electronic diaries and physiological sensors. (Shiffman, Stone, & Hufford, 2008; Wenze & Miller, 2010). During each ABP monitoring session, the participant completed a digital diary (Personalized Digital Assistant Diary, PDA) that posed questions about her activities and mood state each time she heard the blood pressure monitor begin to collect data. EMA of current mood state was repeated during a contiguous 24-hour period to increase reliability.

Serial Salivary Cortisol Collection. To collect the samples, the participant was provided with six specially–designed cotton swabs in a bottle with a Medication Event Monitoring System (MEMS) cap (Aardex, Union City, CA). This cap recorded the time that the participant opened the bottle to collect the cortisol sample. The oral swab method was used for salivary collection, and swabs were placed in labeled Salivette tubes corresponding to the time of collection. Following initial collection during the study session visit, the participant continued sample collection at home according to a variable schedule accounting for the time of initial collection: (1) awakening, (2) 45 minutes after awakening, (3) 2.5 hours after awakening, (4) 3.5 hours after awakening, (5) 8 hours after awakening, and (6) at 10PM or before bedtime. Participants were instructed to return cortisol samples to the laboratory when they returned their ambulatory blood pressure equipment. The cortisol samples are kept frozen until assayed using a commercial ELISA kit (Salimetrics, State College, PA). Each salivary cortisol collection was repeated during a contiguous 24-hour period to increase reliability. Participants who enrolled in their second trimester of pregnancy underwent only two cortisol sample collections.

Corticotropin-releasing hormone (CRH) and cytokines. Blood (10 ml. samples) were collected in EDTA tubes, spun down, and the plasma frozen for later assay of Corticotropin-Releasing Hormone (CRH), and pro-inflammatory cytokines (C-reactive protein (CRP) and Interleukin -6 (IL-6)). The samples were stored in the CRC facilities until they were transported to Dr. Margaret Altemus' laboratory at Cornell for analysis. Blood samples were transported in ice packed containers in person on a weekly basis.

Urine drug toxicology. Each participant had one urine toxicology screen that is randomly scheduled during the pregnancy. The urine drug toxicology screen is performed to screen for cotinine, cocaine, amphetamines, cannabinoids and benzodiazepines.

Fetal heart rate and movement. During both fetal sessions, the fetus was exposed to an externally presented speech sound stimulus. The fetal response to the stimulus is recorded using a Toitu Actocardiogram machine. This monitor recorded fetal heart rate and movement. During the second fetal testing session, the sound paradigm was repeated.

Newborn heart rate, respirations, temperature and sleep state. During the newborn session, infant heart rate, respirations, temperature and sleep state were assessed while the newborn underwent an orthostatic challenge. All studies were conducted between twelve to thirty hours following birth at Morgan Stanley Children's Hospital at CUMC. The infants were tested immediately post-feeding to maximize the likelihood that they would be sleeping. After being brought to the testing room, easily detachable electrodes for monitoring respiration and heart rate were placed on the infant's back and a temperature lead was placed on the infant's flank. A second temperature lead was attached to the testing bassinet to monitor the ambient temperature. The infants were lightly swaddled and placed in the prone position in the testing bassinet. This specially equipped bassinet had a movement sensor beneath the mattress and was

designed to allow for bi-directional tilts of up to 45°. After 10 minutes of baseline recording, the tilting protocol was initiated. With the infant securely in the bassinet, a custom-designed mechanism tilted the infant bassinet from +45° to -45°. Tilts were performed in a fixed sequence of six alternating head-up and head-down tilts. The angular change occurred over a 30-second period and the new position was maintained for 120 seconds. At the end of the 120-second period, the infant was returned to the horizontal position. After 120 seconds in the horizontal position, the next tilt was initiated. Tilts were not initiated within 30 seconds of periods of fussing or sustained whole body movements. Sleep states were coded once each minute through both the baseline and tilt portions of the testing session. Mothers were invited to accompany their baby to the testing session or they could stay in their hospital room.

Table of physiological measures and collection schedule

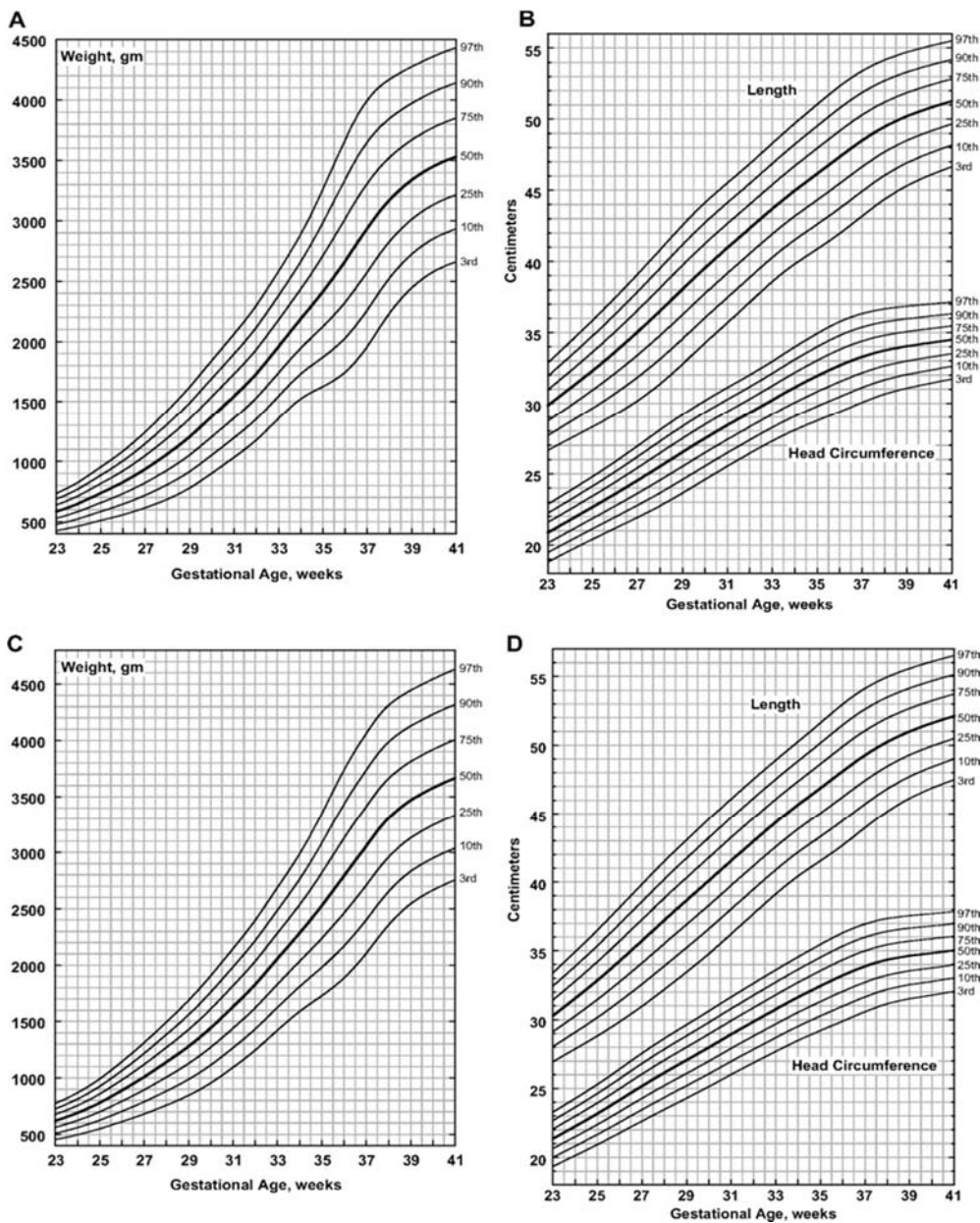
Parent Study Session Schedule								
	ABP 1	APB 2	Blood draw session # 1	Fetal session # 1	Blood draw session #2	ABP 3	Fetal session # 2	Newborn Session
Maternal BP	✓	✓		✓		✓	✓	
Maternal HR	✓	✓		✓		✓	✓	
Maternal respirations				✓			✓	
Maternal EMA	✓	✓				✓		
Salivary cortisol	✓	✓				✓		
CRH			✓		✓			
CRP			✓		✓			
IL-6			✓		✓			
Urine for toxicology*								
Fetal HR				✓			✓	
Fetal movement				✓			✓	
Newborn HR								✓
Newborn respirations								✓
Newborn temperature								✓
Newborn sleep state								✓

ABP: Ambulatory blood pressure; BP: Blood pressure; CRH: Corticotropin releasing hormone; CRP: C-reactive protein; EMA: Ecological momentary assessment; HR: Heart rate; IL-6: Interleukin -6

* One urine toxicology screen is scheduled randomly during the pregnancy

Appendix C

New Intrauterine Growth Curves Based on United States Data



New gender-specific intrauterine growth curves for girls' weight-for-age (A), girls' length- and HC-for-age (B), boys' weight-for-age (C), and boys' length-and-HC-for-age (D). Of note, 3rd and 97th percentiles on all curves for 23 weeks should be interpreted cautiously given the small sample size; for boys' HC curve at 24 weeks, all percentiles should be interpreted cautiously because the distribution of data is skewed to the left. Source: (Groverman, 2008; Olsen, Groverman, Lawson, Clark & Zemel., 2010)

Appendix D

Prenatal self-report questionnaires

Prenatal questionnaire Title	Timing of Administration		
	At enrollment (either ABP session 1 or 2	At ABP session 3	During all three ABP sessions
The Acculturation, Habits, and Interests Multicultural Scale for Adolescents (AHIMSA)	✓		
Attachment Style Questionnaire (ASQ)	✓		
Childhood Trauma Questionnaire (CTQ)	✓		
Coddington Life Events Schedule (CLES-A)	✓		
Dysfunctional Attitudes Scale (DAS)			✓
The Eating Attitudes Test (EAT-26)	✓		
Experience of Discrimination (EOQ)			✓
Perceived Stress Scale (PSS)			✓
Physical Activity Record (PAR)			✓
Pittsburgh Sleep Quality Index (PSQI)			✓
Pregnancy Wantedness (PW)			✓
Posttraumatic Stress Symptom Scale-Interview Version (PSSI)		✓	
Prenatal Distress Questionnaire (PDQ)			✓
Reynolds Adolescent Depression Scale (RADS)	✓		
Ruminations Scale (RS)			✓
Short Acculturation Scale for Hispanics (SASH)	✓		
Social Support Questionnaire (SSQ)	✓		
Symptom Checklist -90 (SCL-90)			✓

Note: Shaded text indicates questionnaires used in dissertation study