

THE EFFECTS OF PRENATAL MATERNAL STRESS ON TODDLER BODY MASS INDEX (BMI) AS MEDIATED BY BIRTHWEIGHT AND MODERATED BY SOCIAL SUPPORT: THE IOWA FLOOD STUDY



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ABSTRACT

INTRODUCTION: The intrauterine environment plays an important developmental role in obesity risk, both directly through effects on central regulators of metabolism, as well as through effects on early growth patterns that alter the child's long-term developmental trajectory. One prenatal factor linked to increased obesity risk is exposure to prenatal maternal stress (PNMS). In addition, a lack of social support in perinatal women has been linked to increased depression levels, pregnancy complications, as well as offspring birth weight which may prime the newborn for greater adiposity later in childhood.

OBJECTIVE: Our goal was to determine the moderating role of social support in the association between prenatal maternal stress (PNMS) and early childhood body mass index (BMI) in the context of the Iowa floods of 2008. In addition, the mediating role of offspring birth weight in the association between PNMS and childhood BMI was examined.

METHOD: The Iowa Flood Study was appended onto an existing study of pregnant women in Eastern Iowa. We re-recruited women from that study who were pregnant in June 2008 when disastrous floods occurred and who had completed a measure of social support before the flood. Within weeks of the flood, women completed self-report measures of PNMS: their objective degree of hardship, their subjective distress, and their cognitive appraisal of the consequences of the flood (negative, neutral, positive). Offspring anthropometric measures were collected at birth, and at 30 months their body mass index (BMI) was calculated.

RESULTS: Moderated mediation results indicated that greater PNMS predicted greater BMI at age 30 months, through effects on higher birthweight as a mediator, but only for participants with low social support. High social support (satisfaction or number) buffered the effect of PNMS on birthweight. The combination of high PNMS and low social support resulted in higher offspring birth weight, which predicted greater BMI at 30 months.

CONCLUSION: Efforts to provide strong social support to pregnant women following a stressor might buffer the effects of PNMS on offspring birthweight and later obesity.

INTRODUCTION

- Worldwide, 42 million children under 5 years of age are overweight (1)
- In the U.S. 17% of children aged 2-19 years are obese
- 77% of obese children remain obese as adults
- The intrauterine environment plays an important developmental role in obesity risk, both directly through effects on central regulators of metabolism, as well as through effects on early growth patterns that alter the child's long-term developmental trajectory
- Animal studies have linked prenatal maternal stress (PNMS) to offspring obesity via effects of maternal stress hormones on the developing fetus
- A prospective human study of prenatal maternal stress (PNMS), Project Ice Storm, showed that greater disaster exposure in pregnancy predicted obesity and higher Body Mass Index (BMI) at age 5½¹, and that the magnitude of the association increased with age².
- It is unknown, however, whether social support can buffer pregnant women from the effects of an external stressor and the subsequent distress that gets transmitted to the unborn child, raising its risk of obesity in later life.
- In mid-June 2008, the state of Iowa experienced its worst flooding in 50 years. 85 of Iowa's counties were declared disaster zones.
- Beginning in 2007, a University of Iowa PhD student (Kimberly Nylén Hunt) had been recruiting pregnant woman for a study of prenatal stress and obstetric complications. Many of these women were still pregnant at the time of the floods. She assessed the women's psychological symptoms and degree of social support *before the flooding occurred*.
- The Iowa Flood Study piggy-backed on Nylén-Hunt's study and re-recruited these women and many more.

OBJECTIVES

Our objectives were to determine the extent to which Prenatal Maternal Stress (PNMS) from a natural disaster predicts child BMI at age 2½ as mediated by birth weight and as moderated by maternal social support.

METHODS

Participants
Women: Participants were >18 years old and pregnant during the flooding with a singleton (n = 103).
Children: 56 boys and 47 girls. At 2½, BMI ranged from 14 – 20, M=16.2, SD = 1.3.

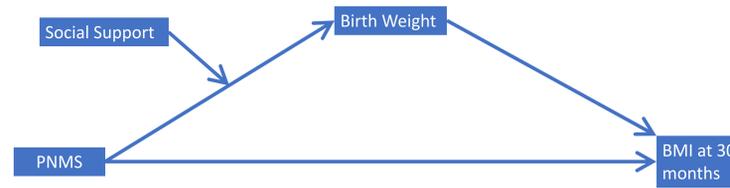
Instruments
Objective PNMS (IF100): We created a scale to assess objective levels of exposure in 4 categories: Threat, Loss, Scope, Change. This scale is called the Iowa Flood 100 (IF100).
Cognitive Appraisal: Women were asked "If you think about all of the consequences of the flood on your family members and on yourself, would you say that the flooding has been: ____?" 46% rated as Negative or Very Negative; 54% rated as Neutral or Positive.
Subjective PNMS (PDI, PDEQ, IES-R, COSMOSS): A composite measure of subjective stress (COSMOSS; Composite Score for MOthers' Subjective Stress) was calculated using Principal Components Analysis (PCA) based on scores for the Peritraumatic Distress Inventory (PDI), the Peritraumatic Dissociative Experiences Questionnaire (PDEQ), and the Impact of Event Scale – Revised (IES-R). This scale has a mean of 0 and SD = 1.
Social Support Questionnaire (SSQ): Provides data on the **Number** of people on whom the woman can count in six different scenarios, and their **Satisfaction** with their support.
Children's BMI at age 2½: BMI was calculated from height and weight (kg/m²)

Procedure
 As part of the original Nylén study, women completed the SSQ while pregnant. Women were recruited within a few months of the flood, and completed the PNMS questionnaires. Children were assessed at age 2½.

RESULTS: MODERATED MEDIATION ANALYSES

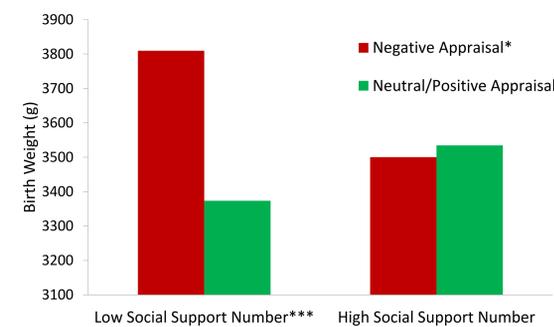
THEORETICAL MODEL

The tested theoretical model was that social support (either Number of persons or support Satisfaction) would moderate the effect of PNMS on birth weight, which would then influence the child's BMI level at 30 months.

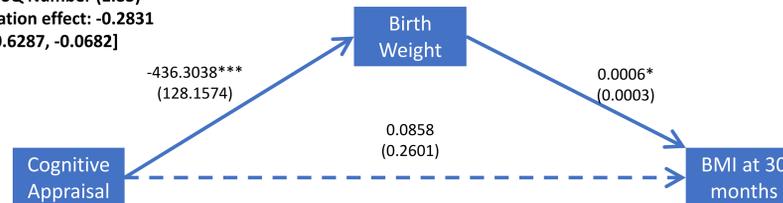


COGNITIVE APPRAISAL MODERATED BY SOCIAL SUPPORT NUMBER

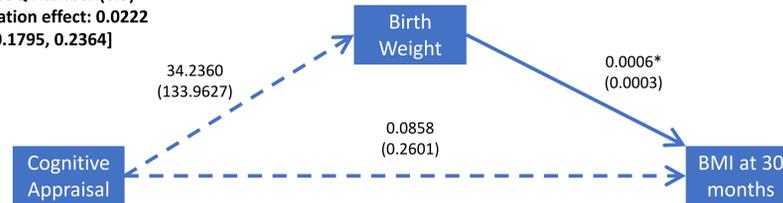
A significant moderated mediation was found, such that **social support number** significantly moderated the effect of cognitive appraisal on birth weight, which in turn had a significant effect on BMI at 30 months. Probing this effect showed that **for low social support, a negative cognitive appraisal resulted in higher birth weight, which then predicted higher BMI at 30 months**. However, no significant effect was detected for high social support number.



Low SSQ Number (1.83)
Mediation effect: -0.2831
CI=[-0.6287, -0.0682]



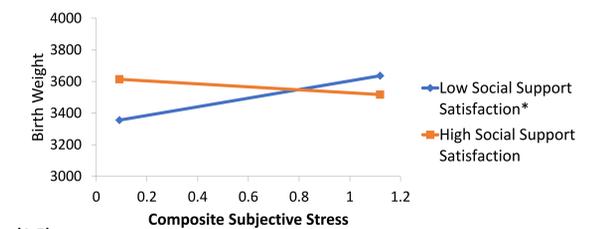
High SSQ Number (6.5)
Mediation effect: 0.0222
CI=[-0.1795, 0.2364]



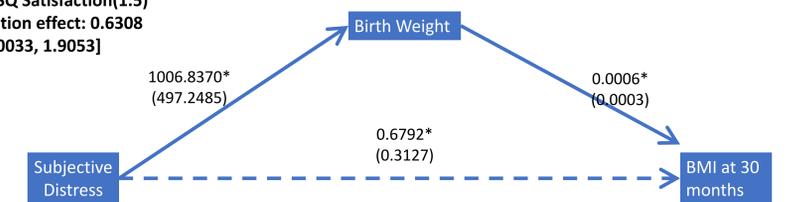
RESULTS (CONTINUED)

SUBJECTIVE STRESS MODERATED BY SUPPORT SATISFACTION

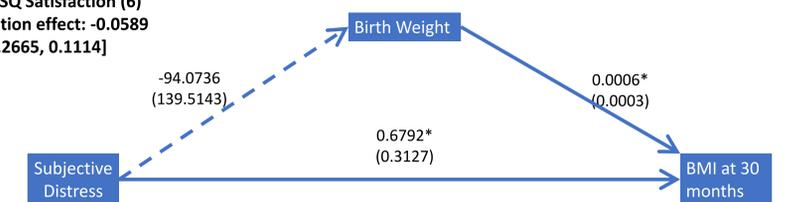
Another similar moderated mediation was found, showing that **for low social support satisfaction, higher subjective stress resulted in higher birth weight, which then predicted higher BMI at 30 months**, while no significant effect was detected for high social support number.



Low SSQ Satisfaction (1.5)
Mediation effect: 0.6308
CI=[0.0033, 1.9053]



High SSQ Satisfaction (6)
Mediation effect: -0.0589
CI=[-0.2665, 0.1114]



CONCLUSIONS AND DISCUSSION

- We examined the effect of prenatal maternal stress, birth weight, and social support on BMI in early childhood.
- For women with fewer support providers, a negative appraisal of the consequences of the flood predicted their children's higher BMI at 30 months through a higher birth weight.
- This effect was not observed in mothers with high social support for whom there was no association between their cognitive appraisal and the child's birthweight or BMI at 30 months.
- Similar effects were observed for maternal subjective distress (COSMOSS) and social support satisfaction.
- The results suggest that high social support acts as a buffer for maternal stress and the negative appraisal of consequences from a stressful event.

References:

- Dancause, K. N. *et al.* Prenatal exposure to a natural disaster increases risk for obesity in 5 ½ year old children. *Pediatr. Res.* **71**, 126-131 (2012).
- Liu, G. T., Dancause, K., Elgbeili, G., Laplante, D. P. & King, S. Disaster-related prenatal maternal stress explains increasing amounts of variance in body composition through childhood and adolescence: Project Ice Storm. *Environ. Res.* **150**, 1-7, doi:dx.doi.org/10.1016/j.enres.2016.04.039 (2016).

