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Short communication

Maternal medical risks during pregnancy and childhood externalizing behavior

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ABSTRACT

Rationale: Research has indicated that maternal health during the prenatal period and at delivery carries far reaching significance for the development of offspring. Even so, the role of the accumulation of maternal medical risks during pregnancy in the development of externalizing behavior during childhood has generally been overlooked.

Objective: The present study investigates whether the accumulation of maternal medical risks during the prenatal period is positively associated with childhood externalizing behavior, and whether this association is stronger among male offspring.

Method: We examined a large, nationally representative sample of children who participated in the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B). Information concerning maternal medical history, including the presence of a number of medical risks during pregnancy, was obtained through hospital records. A subsample of children with both parent and teacher reports of externalizing behavior during kindergarten was employed in the present study.

Results: A greater number of maternal medical risks during pregnancy increased the odds of childhood externalizing behavior across settings, but only among male offspring. The predicted probability of persistent externalizing behavior among males increased from .084 in the absence of maternal medical risks during pregnancy to .241 in the presence of three or more maternal medical risks during pregnancy.

Conclusions: Our findings suggest that maternal medical risks during the prenatal period can have far-reaching consequences for the behavioral development of male offspring. Treatment of medical risks among expectant mothers may have the added benefit of reducing the likelihood of childhood externalizing behavior among male progeny.

1. Introduction

Maternal health during the prenatal period and at delivery carries far reaching significance for the health of offspring (Boomsma et al., 2006; Catalano and Ehrenberg, 2006; Dennedy and Dunne, 2010). A diverse array of factors, including obesity and gestational diabetes, have been linked to the cognitive and physical health of offspring across multiple developmental stages (Boomsma et al., 2006; Catalano and Ehrenberg, 2006; Dennedy and Dunne, 2010). For instance, a study by Dennedy and Dunne (2010) suggests that health conditions during pregnancy, including gestational diabetes, have important implications for various fetal health outcomes as well as time spent in neonatal intensive care. A review of the literature by Catalano and Ehrenberg (2006) also indicates that obesity in pregnancy has particularly far-reaching consequences for offspring, impacting their own risk of

obesity, hypertension, glucose intolerance, and risk of type 2 diabetes during later life stages.

Despite this body of research on the role of maternal prenatal health in the health and wellbeing of offspring, relatively little research has accrued regarding the influence of maternal prenatal health on behavioral development, namely childhood externalizing behavior, during these sensitive time periods. Several scholars have partially addressed this gap in the literature by investigating the effects that birth complications (e.g., umbilical cord prolapse, meconium) have on increasing the probability of externalizing behavior across childhood and adolescence (Arseneault et al., 2002; Beaver and Wright, 2005; Raine et al., 1994, 1997). Despite this line of research, the role of maternal medical risks during pregnancy in the development of offspring externalizing behavior is less commonly investigated (see Robinson et al., 2009). Studies on the accumulation of prenatal medical risks, and its role in

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offspring behavioral outcomes, have been particularly sparse.

Even so, prior research has revealed that a host of stress-inducing events during pregnancy – from chronic homelessness to personal tragedy – can interfere with fetal health and well-being (Dunkel Schetter, 2011). It is reasonable to suggest that health problems during the prenatal period may set into motion a deleterious cascade of maternal symptoms of anxiety and stress, resulting in increased hormone elevations capable of impacting offspring development (Gourounti et al., 2015; Weinstock, 2008). Moreover, these factors may be particularly harmful for males, as prior research has highlighted the greater propensity that males in general have towards externalizing behavior (Eme, 2010; Moffitt et al., 2001). Males are also more likely to possess difficult temperaments during the early life course, which may increase their susceptibility to maternal stressors (Bradley and Corwyn, 2008). The objective of the present study is to shed light on the link between maternal medical risks during pregnancy and subsequent problem behaviors of offspring during childhood. Rather than posit that one single medical condition/risk will possess unique effects, we hypothesize that

- 1) *Cumulative* maternal medical risks during pregnancy will be associated with an increased risk of childhood externalizing behavior.
- 2) The association between cumulative maternal medical risks during pregnancy and childhood externalizing behavior will be more pronounced among male offspring.

The findings of the present study possess important implications. If modifiable cumulative maternal medical risks are indeed linked to childhood behavioral problems, then addressing these medical risks before or during pregnancy may provide an additional avenue for the prevention of childhood-onset problem behaviors.

2. Methods

2.1. Sample

Data come from the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B), sponsored by the Institute of Education Sciences (IES). The ECLS-B examines a large, nationally representative sample of children who were born in the United States in 2001. The sample was obtained from a nationally representative list of birth certificates provided by the National Center for Health Statistics (NCHS), which covers 99% of all U.S. births in a given year. These children were followed from birth through their kindergarten school year. Data were collected across five waves from a variety of reporting sources, including hospital and parental reports, and using multiple methods (e.g., observational, self-report, direct assessment). The hospital records data, obtained through NCHS, contain information on various medical risks exhibited by the mother during the pregnancy. For a subsample of children ($N = 4998$), both parent and teacher reports of the child's social, emotional, physical, and behavioral development during kindergarten were obtained. After partitioning the models by gender (i.e., the moderator in our analyses), final sample sizes were 2521 males and 2477 females. To address issues related to missing data, multiple imputation (MI) was conducted employing MI commands in STATA 14 (1344 of the 4998 cases were missing data on at least one of the covariates). Thus, we present pooled estimates that are derived from numerous imputed data sets. Importantly, results were robust to the number of iterations (e.g., 5, 20, etc.) and list-wise deletion results were substantively similar.

2.2. Measures

Five parent-rated items and five teacher-rated items from the Preschool and Kindergarten Behavior Scales – Second Edition (PKBS-2) were employed to measure childhood externalizing behavior. These questions cover the following domains: impulsivity (e.g., the child acts

without thinking), aggression (e.g., the child hits, kicks, or pushes others), provocation (e.g., the child annoys/bothers other children), temper (e.g., the child has temper tantrums), and overactivity (e.g., child is unable to sit still). Response options for these ten items (five parent-rated items and five teacher-rated items) included 1 (never), 2 (rarely), 3 (sometimes), 4 (often), and 5 (very often). Responses were re-coded in an effort to identify those children who exhibit more persistent externalizing behavior across settings. First, scores on the items were dichotomized, with scores of 4 or 5 (i.e., often or very often) being assigned a value of 1, and lower scores being assigned a value of 0. Next, children who were assigned a value of 1 on both parent and teacher reports on at least one of the problem behavior dimensions were ultimately designated as exhibiting persistent behavioral problems across settings (which equates to roughly 8% of the final sample). Cohen's κ s suggest a statistically significant and quite strong agreement between parent and teacher reports across the behavioral dimensions being examined (e.g., 84% agreement on overactivity, 84% agreement on impulsivity, 87% agreement on temper, 91% agreement on provocation, 92% agreement on aggression, $ps < .01$). Ultimately, only those subjects who exhibited more frequent behavioral problems across settings were designated as problematic, as prior theory and research suggest that such behaviors are most likely to persist into later life stages (Caspi et al., 1996; Moffitt and Caspi, 2001). The coding was also consistent with the distribution of the items themselves (positive skew), as it permitted the identification of children who represented the tail of the distribution of the items (8%). We follow the lead of a number of other studies that have employed logistic regression to predict frequent/severe problem behaviors in both infants and children in an effort to identify clinically significant or clinically meaningful scores (Chapman et al., 2010; Lumeng et al., 2003; Stene-Larsen et al., 2009). Alternative coding did not alter the results of the study.

Information regarding maternal health during the prenatal period and at delivery come from the technical appendix of the *Vitality Statistics of the United States, 2001, Volume 1, Natality* published by the Center for Disease Control and Prevention's (CDC) National Center for Health Statistics (NCHS). These records were used to obtain information on a number of prenatal factors, including the presence (or absence) of anemia, cardiac disease, acute/chronic lung disease, diabetes, genital herpes, oligohydramnios, hypertension/preeclampsia, eclampsia, incompetent cervix, previous neonate over 400 g, previous preterm delivery, renal disease, Rh sensitization, uterine bleeding, obesity, and other medical risks during pregnancy. The total number of risks were ultimately summed to create a composite measure of maternal medical risks during the pregnancy. Although the maximum number of risks experienced by any single mother was six, we opted to truncate this variable at a score of three, as less than 1% of the final sample exhibited more than three prenatal medical risks.

A number of covariates pertaining to the mother, the offspring, and the household were also included in the analysis. The included covariates are child's race (1 = nonwhite, 0 = white) and child's age (ranging from 57.2 to 85.1 months in the final sample), both of which are robust correlates of externalizing behavior. Low SES (a composite of maternal and paternal employment, income, and occupational prestige divided into quintiles; see Moss and Yeaton, 2011), maternal antisocial behavior (i.e., a cumulative count variable ranging from 0 to 6 including whether the mother has been fired from a job, expelled from school, using illicit substances, arrested, committed to a mental health facility, and convicted of driving under the influence), low parental involvement (i.e., continuous index of the extent to which mothers read books, sang songs, and told stories to their child at wave 1. $\alpha = 0.66$), and prenatal care quality (i.e., using the Kessner Adequacy of Prenatal Care Index, which is a function of when prenatal care began and how many visits occurred during the pregnancy; See Kotelchuck, 1994) were also included, due to their associations with child externalizing behavior and/or the degree or medical risk during pregnancy. Associations between medical risks of the mother and child behavioral problems

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