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Research report

Low maternal sensitivity at 6 months of age predicts higher BMI in 48 month old girls but not boys ☆

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ABSTRACT

Background: Large population-based studies suggest that systematic measures of maternal sensitivity predict later risk for overweight and obesity. More work is needed to establish the developmental timing and potential moderators of this association. The current study examined the association between maternal sensitivity at 6 months of age and BMI z score measures at 48 months of age, and whether sex moderated this association. *Design:* Longitudinal Canadian cohort of children from birth (the MAVAN project). *Methods:* This analysis was based on a dataset of 223 children (115 boys, 108 girls) who had structured assessments of maternal sensitivity at 6 months of age and 48-month BMI data available. Mother–child interactions were videotaped and systematically scored using the Maternal Behaviour Q-Sort (MBQS)-25 items, a standardized measure of maternal sensitivity. Linear mixed-effects models and logistic regression examined whether MBQS scores at 6 months predicted BMI at 48 months, controlling for other covariates. *Results:* After controlling for weight-relevant covariates, there was a significant sex by MBQS interaction ($P = 0.015$) in predicting 48 month BMI z. Further analysis revealed a strong negative association between MBQS scores and BMI in girls ($P = 0.01$) but not boys ($P = 0.72$). Logistic regression confirmed that in girls only, low maternal sensitivity was associated with the higher BMI categories as defined by the WHO (i.e. "at risk for overweight" or above). *Conclusions:* A significant association between low maternal sensitivity at 6 months of age and high body mass indices was found in girls but not boys at 48 months of age. These data suggest for the first time that the link between low maternal sensitivity and early BMI z may differ between boys and girls.

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Introduction

It has been argued that the very rapid increase in obesity rates over recent decades cannot be accounted for based on purely metabolic factors, and must relate in large part to one or more environmental factors (Gundersen, Mahatmya, Garasky, & Lohman, 2011; Lajunen, Kaprio, Rose, Pulkkinen, & Silventoinen, 2012; Puder & Munsch, 2010; Suglia, Duarte, Chambers, & Boynton-Jarrett, 2012; Vámosi, Heitmann, & Kyvik, 2010). As summarized in recent reviews (Anzman, Rollins, & Birch, 2010; Mitchell, Farrow, Haycraft, & Meyer, 2013; Sleddens, Gerards, Thijs, de Vries, & Kremers, 2011; Ventura & Birch, 2008), the quality of parent–child interactions has been a focus of obesity work over several decades. However, much of this work has been either cross-sectional in design, done in relatively small samples and/or focused on school-age children and adolescents, which may limit the interpretation and generalizability of results. A greater focus on large, longitudinal, population-based studies, including data from the first few years of life, may point the way to more effective interventions going forward (Anzman et al., 2010).

One systematic way of assessing the quality of early parental–child relationships is to measure maternal–infant attachment and maternal sensitivity based on direct observation using standardized coding to score these interactions. Attachment can be defined as a bio-behavioural system to facilitate protection and survival through proximity and a secure base between mammalian caregivers and their infants (Bowlby, 1973; Goldberg, 2000). Maternal sensitivity refers to one specific aspect of the attachment system i.e. timely and appropriate responsivity on the part of the mother towards the cues of her infant (Ainsworth & Marvin, 1995). In addition to providing a framework for the objective and standardized assessment of parent–child interactions, attachment and maternal sensitivity have the further advantage of contributing to individual differences in emotion regulation (Sherman, Stupica, Dykas, Ramos-Marcuse, & Cassidy, 2013; Waters et al., 2010) and stress responsivity (Champagne & Meaney, 2001; Fernald & Gunnar, 2009; Loman & Gunnar, 2010; Walker, 2010). Increased consumption of highly palatable foods in the face of strong emotions, often triggered by daily stressors, is thought to be a major factor contributing to obesity over time (Dallman et al., 2003). Given these practical and theoretical advantages, standardized assessments of attachment and maternal sensitivity have recently been included in large, systematic population studies of obesity risk. For example, Anderson and Whitaker in 2011, using a version of the Attachment Q-sort (van Ijzendoorn, Vereijken, Bakermans-Kranenburg, & Riksen-Walraven, 2004; Waters & Deane, 1985) in a large U.S. population sample, found that attachment insecurity measured at 24 months increased the risk of obesity at 54 months of age. This same team later showed that low maternal sensitivity in the pre-school years was an even stronger risk factor for the development of obesity in adolescence than insecure attachment (Anderson, Gooze, Lemeshow, & Whitaker, 2012). Wu, Dixon, Dalton, Tudiver, and Liu (2011) showed that the combination of low maternal sensitivity and a difficult child temperament predicted an increased risk of overweight-or-obesity during school age, but not in earlier childhood.

While these initial studies suggest that insecure attachment and low maternal sensitivity in pre-schoolers is a risk factor for later obesity, much more work is needed to replicate these findings in independent samples and to establish at what age these effects first come into play. For example, while Anderson et al. (2012) report a link between 24 month attachment behaviours and later obesity risk, extending this finding to interactions measured at 6 months of age might inform a different interventional approach implemented at a very different time in the emerging dyadic relationship. Another important question for this area of work is whether sex moderates the link between attachment and/or maternal sensitivity behaviours and later obesity risk. Anderson and Whitaker (2011) reported that sex did not moderate the association between insecure attachment and childhood obesity; however, they did not report on similar moderation effects related to maternal sensitivity and later weight gain (Anderson et al., 2012). Several authors have identified important sex differences associated with the early mother–child relationship and the development of social interactions (Biringen, Robinson, & Emde, 1994; Goldberg & Lewis, 1969; Gunnar & Donahue, 1980; Hinde & Stevenson-Hinde, 1987). Furthermore, several aspects of eating behaviour and weight gain may develop differently in girls and boys (Govindan et al., 2013; Suzuki et al., 2012). Thus, it is reasonable to hypothesize that the link between maternal sensitivity and later obesity risk might differ in the two sexes.

The main goals of the current study were thus: 1) to examine the association between 6 month maternal sensitivity scores and body mass indices measured at 48 months of age in a new longitudinal study of developing children, thus extending the work of Anderson et al. to an earlier developmental stage, and 2) to assess whether sex might moderate this association. We hypothesized that exposure to low maternal sensitivity at age 6 months would be associated with higher child BMIs at age 48 months, and that sex would moderate this association i.e. that girls would show this association more so than boys. The latter was based on recent work demonstrating a link between social adversity and obesity risk in girls but not in boys at 5 years of age (Suglia et al., 2012). Differences in parental expectations, perceived roles and maternal behaviours towards boys and girls might also be contributory in this regard (Biringen et al., 1994; Carper, Fisher, & Birch, 2000; Elfhag & Linné, 2005; Goldberg & Lewis, 1969; Hinde & Stevenson-Hinde, 1987).

Participants and methods

The current study sample included 223 children recruited in either Montréal, Québec (N = 105) or Hamilton, Ontario (N = 118), Canada as part of an established prospective birth cohort, the Maternal Adversity, Vulnerability and Neurodevelopment (MAVAN) project. For the current analysis, all available participants who had been enrolled in the MAVAN study at birth, been scored for maternal sensitivity at 6 months of age and who had participated in a laboratory visit to measure growth at 48 months of age were included. Eligibility criteria for mothers at study entry included age ≥18 years, singleton gestation, and fluency in French or English. Women with severe chronic illness, placenta previa, with history of incompetent cervix, impending delivery, or a foetus/infant affected by a major anomaly or born at a gestational age less than 37 weeks were excluded. Birth records were obtained directly from the birthing unit.

The current study sample was found to be comparable to the overall birth cohort in terms of maternal age at childbirth, gestational age, birth size, income categories, and maternal education. MAVAN is a multidisciplinary, collaborative study, recruiting pregnant women from obstetric clinics in hospitals located in Montréal, Québec and Hamilton, Ontario. All participants experienced identical home and laboratory based assessments. We excluded very low birth weight infants and included those born at 37–41 weeks gestation. The maternal age at childbirth was also comparable to the general population within Canada (study sample = 30.5 years; Québec = 29.5 years, Ontario = 30.2 years) (Statistics Canada, 2012). The MAVAN project over-samples from low SES settings, thus the prevalence of families receiving income below the low income cut off (LICO; Statistics Canada, 2005) was near 30% compared to 15% in the general population (Statistics Canada, 2009). However, while education below 10 years was found in only 4% of the mothers of our sample, this number reaches 12% of adults in the provinces of