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Research report

Infant and maternal predictors of early life feeding decisions. The timing of solid food introduction [☆]

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ABSTRACT

There is limited research on the maternal and infant characteristics associated with the timing of solid food introduction. The current study examined how maternal feeding style and infant temperament independently and interactively predicted the age at which infants were introduced to solid food. Data from 115 predominately white, middle-class mothers were collected when infants were 4 and 6 months of age. The timing of solid food introduction was positively correlated with mothers' age, education, breastfeeding at 4 months, self-reported responsiveness to infants' hunger and satiety cues, and negatively correlated with mothers' pre-pregnancy body mass index (BMI), beliefs about feeding infants solid food prior to 6 months of age, and infants' temperamental motor reactivity. When controlling for maternal age, education, pre-pregnancy BMI, and milk feeding method at 4 months, the timing of solid food introduction was negatively predicted by mothers' beliefs about feeding solid food prior to 6 months of age. Exploratory interaction analyses suggested that infant temperament marginally moderated maternal feeding style in predicting the timing of solid food introduction.

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Introduction

To support healthy physical and cognitive development, the American Academy of Pediatrics advises exclusive breastfeeding for the first 6 months of life, followed by an additional 6 months or more of breastfeeding while complementary foods (i.e. nutritive substances other than breast milk or formula; hereafter referred to as "solid food") are introduced (Eidelman & Schanler, 2012). Prior to the 2012 update, solid food introduction was recommended between 4 and 6 months (Gartner & Eidelman, 2005). Despite this recommendation, approximately 40% of infants in the United States are introduced to solid food before 4 months of age (Clayton, Li, Perrine,

& Scanlon, 2013; Grummer-Strawn, Scanlon, & Fein, 2008). Even though there are theories and empirical evidence to support a bi-directional relationship between parents and infants (Sameroff, 2009) and that this relationship operates within the feeding context (Birch, 1999; Hughes, Power, Orlet Fisher, Mueller, & Nicklas, 2005), few studies have examined how maternal and infant characteristics predict the timing of solid food introduction, either alone or in combination (Jansen, Daniels, & Nicholson, 2012; Patrick, Hennessy, McSpadden, & Oh, 2013). The current study addressed this gap in the literature by examining the influence of maternal feeding style and infant temperament on the age at which infants were introduced to solid food.

Introducing solid food to infants prior to 4 to 6 months of age may be associated with the development of obesity, however the evidence is mixed (Huh, Rifas-Shiman, Taveras, Oken, & Gillman, 2011; Moorcroft, Marshall, & McCormick, 2011; Woo et al., 2013). Infants who are introduced to solid foods earlier have been found to consume more energy-dense foods (Robinson et al., 2007), which may promote excess caloric consumption and lead to rapid weight gain (Briefel, Reidy, Karwe, Jankowski, & Hendricks, 2004). Given the high prevalence of infant and childhood obesity (Ogden, Carroll, Kit, & Flegal, 2014), understanding early life factors that may contribute to its development is important (Paul et al., 2009).

One factor shown to be related to the timing of solid food introduction is the type of milk feeding. Previous research has found that mothers who fed formula exclusively or in combination with

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breast milk were more likely to introduce solid food prior to 4 months than mothers who exclusively breastfed (Armstrong, Abraham, Squair, Brogan, & Merewood, 2014; Clayton et al., 2013; Grummer-Strawn et al., 2008; Kronborg, Foverskov, & Væth, 2014).

Maternal feeding style may also influence the timing of solid food introduction and subsequent childhood obesity risk (Faith, Scanlon, Birch, Francis, & Sherry, 2004; Gerards & Kremers, 2015; Ventura & Birch, 2008). Previous studies have found that a responsive feeding style was related to longer breastfeeding duration (Taveras et al., 2004) and later solid food introduction (DiSantis, Hodges, & Fisher, 2013; Kronborg et al., 2014). Alternatively, controlling feeding styles (e.g., pressuring) have been related to earlier solid food introduction (Brown & Lee, 2013). One purpose of the current study was to extend this research by examining controlling and responsive feeding styles on the timing of solid food introduction beyond that of milk feeding and within the context of maternal demographic and health covariates.

Parent-child relationships are bi-directional, meaning that infant characteristics such as temperament may evoke certain parenting responses and children may respond differently to parenting behaviors (Caspi & Shriner, 2006). In the context of infant feeding, a mother is likely to have pre-existing beliefs about infant feeding (Musher-Eizenman & Kiefner, 2013; Newby, Brodribb, Ware, & Davies, 2014), but if her infant responds in a way that is not consistent with those beliefs she may adjust her feeding decisions to meet her child's nutritional needs. Previous research has found that parents of infants who were higher in negative reactivity were less likely to exclusively breastfeed for six months (Niegel, Ystrom, Hagtvet, & Vollrath, 2008) and more likely to respond to infant crying with feeding (McMeekin et al., 2013; Stifter, Anzman-Frasca, Birch, & Voegtline, 2011). Only two studies have specifically considered how infant temperament relates to the timing of solid food introduction and found that parents were more likely to introduce solid foods earlier to infants that were more negative and motorically reactive than infants who were less reactive (Kronborg et al., 2014; Wasser et al., 2011). Mothers of infants who are high in emotional and/or motor reactivity may have more difficulty distinguishing their infants' reactivity from hunger and fullness cues compared to mothers of infants low in these characteristics (McMeekin et al., 2013), but more research is needed to clarify the role of temperament in the decision to begin solid foods (Worobey, Peña, Ramos, & Espinosa, 2014).

Specific aims

The first aim of this study was to test the independent effects of maternal feeding style and infant temperament on the timing of solid food introduction above and beyond maternal demographic and health characteristics and milk feeding method at 4 months. The second aim was to explore whether infant temperament moderated the effects of maternal feeding style on the timing of solid food introduction. Based on the previously described literature (Brown & Lee, 2013; DiSantis et al., 2013; Kronborg et al., 2014) we hypothesized that mothers who endorsed a highly pressuring feeding style would introduce solid food earlier than mothers who reported less pressuring feeding. Our second hypothesis was that mothers who endorsed a highly responsive feeding style would introduce solid food later than mothers who reported less responsive feeding. Lastly, we hypothesized that infants who were higher in negative or motor reactivity would be introduced to solid food earlier than infants lower in these characteristics. Our interaction analyses were exploratory, thus we asked whether the relationship between feeding style and the timing of solid food introduction was moderated by infant temperament.

Methods

Participants

115 mother-infant dyads (54.8% male infants) were recruited through birth announcements and a local community hospital in central Pennsylvania to participate in a longitudinal study on infants' basic needs (e.g., eating, crying, sleeping, and soothing) and emotional and physical development. Inclusion criteria were: Maternal age ≥ 18 years, full-term (≥ 37 weeks) pregnancy that was without complications (e.g., low birth weight), and plans to remain in the area for two years. Self-report survey data and laboratory observation data were collected within two weeks of the infants turning 4, 6, 12, and 18 months of age. At each time point, participants received surveys prior to their scheduled laboratory visits and were instructed to bring the completed questionnaires with them to their laboratory visit. Data for the present study were drawn from the 4- and 6-month maternal self-report surveys with a few noted exceptions. These time points were selected because they were the closest in time to the age at which solid food was introduced to most infants.

The majority of mothers were multiparous (74.8%) and 24.3% of the infants were first-born children. Participant demographic characteristics reflected the recruitment area. Mothers were an average age of 29.4 years ($SD = 4.93$; range 19–41) and had an average of 14.67 years of education ($SD = 2.05$; range 11–20). The most commonly reported race was Caucasian (93.9%), with few others reporting an Asian (3.5%), African American (1.7%) or American Indian/Alaskan Native (0.9%) race. Infant race was similarly distributed. Most mothers (80.9%) were married, some were single (9.6%), or living with a partner (6.1%), and few were divorced or other (3.4%). Family income levels were widely distributed: 10.5% reported earning $< \$20,000$ per year, 25.2% earned $\$20,000$ – $\$40,000$, 26.1% earned $\$40,000$ – $\$60,000$ per year, 16.5% earned $\$60,000$ – $\$80,000$ per year, and 21.7% earned $> \$80,000$ per year.

One extreme outlier was excluded from analyses as the value for the age at which the infant was introduced to solid food was more than four standard deviations above the mean. There were 4 participants without data for the outcome variable, the age at which infants were introduced to solid food. Mothers with incomplete data (4-month infant cry diaries, $n = 9$; 6-month survey measures, $n = 11$; maternal pre-pregnancy BMI, $n = 14$) were not significantly different on any demographic variable or the outcome variable with one exception: Mothers missing BMI data were significantly less educated than mothers for whom we had BMI data ($p = .01$), but did not differ on the timing of solid food introduction. All other participants had complete data ($n = 94$). All available data were used in the analyses, with the exception of the hierarchical multiple regression analyses in which only cases with complete data were analyzed.

Measures

Maternal pre-pregnancy BMI

At 4 months, mothers reported their weight in pounds prior to their most recent pregnancy. Trained research assistants collected mothers' heights at the 6-month laboratory visit. BMI was calculated using the standard equation $BMI = \text{weight (kg)} / (\text{height (m)}^2)$.

Baby's Basic Needs Questionnaire (BBNQ)

At 4, 6, and 12 months mothers completed the BBNQ (Stifter et al., 2011), in which mothers reported their current milk feeding method and the age of their infant if and when mothers had stopped breastfeeding and/or began feeding formula. Mothers' report of milk feeding at 4 months was used to create three dichotomous variables for milk feeding method: breastfeeding, formula feeding, and

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