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Early mother-child dyadic pathways to childhood obesity risk: A conceptual model.

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Abstract

Understanding the emotional quality of the mother-child dyadic relationship and parent-child feeding interactions may further clarify early developmental pathways to eating behaviours and obesity risk. The quality of parent-child relationships fosters all aspects of child development but has not yet been extensively examined in relation to childhood weight gain. The aim of this paper is to propose a conceptual model, which outlines early mother-child dyadic pathways linking parent-child feeding interactions to child body mass index, where parent-child relationships have a central role. It maps out individual and dyadic mother-child factors (i.e., attachment, child temperament and maternal mental health) that influence the nature and quality of parent-child feeding interactions from infancy to toddlerhood. Our model bridges the gap between research fields by bringing together key maternal and child factors implicated in child development. Understanding early parent-child feeding interactional patterns and their influence on child self-regulation and eating behaviours may be relevant to multidisciplinary approaches toward preventing childhood obesity. High quality quantitative and observational data capturing meaningful parent, child and dyadic level interactions around food contexts, attachment security, maternal mental health, child temperament and self-regulation will help to inform new, aetiologically important, targets for preventative intervention.

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Keywords

Early childhood; Obesity; Parenting; Parent-child feeding interactions; Self-regulation; Attachment

Introduction

Childhood obesity continues to be one of the most challenging public health issues of this century (WHO, 2016). Overweight prevalence amongst children under five years rose from 31 million in 1990 to 41 million in 2014 (WHO, 2016). It is predicted that by 2025, 70 million infants and preschool aged children (0–5 years) worldwide will be affected by overweight and obesity (WHO, 2016). Importantly, obesity-related behaviours are established in early childhood (Han, Lawlor, & Kimm, 2010) and track through to adulthood and early childhood overweight and obesity is associated with long-term above optimal weight status (Singh, Mulder, Twisk, Van Mechelen, & Chinapaw, 2008). A recent meta-analysis showed children with obesity have a fivefold increased risk of being affected by obesity in adulthood (Simmonds, Llewellyn, Owen, & Woolacott, 2016). Another study tracking children at two and again at five years of age showed children with obesity are more likely to be admitted to hospital and have a 60% higher health care costs compared to children with healthy weight status (Hayes et al., 2016). Implications of early childhood overweight and obesity extend beyond physical health during later stages of childhood and adulthood, negatively impacting self-esteem and mental health (e.g., Russell-Mayhew, McVey, Bardick, & Ireland, 2012), long-term education (e.g., Cohen, Rai, Rehkopf, & Abrams, 2013) and quality of life (e.g., Wille, Erhart, Petersen, & Ravens-Sieberer, 2008). Hence, understanding early risk factors for obesity, when biology and behaviour are more malleable, is crucial for informing prevention strategies.

The causes of childhood obesity are complex, extending from genetic to non-genetic influences (Han et al., 2010), including family and community/societal factors (Harrison et al., 2011; Mihrshahi & Baur, 2018). Over the past decades, obesity researchers have used Ecological Systems Theory to summarise the complex interplay between these multidimensional contributors to excess child weight development and inform childhood obesity research and prevention strategies (Birch & Fisher, 1998; Harrison et al., 2011). Ecological Systems Theory places parent and child factors as the most proximal influences on the development of overweight and obesity during early childhood. In relation to child eating, these factors include child self-regulation, parental feeding practices, and family meal climate (Harrison et al., 2011).

Ecological System Theory acknowledges that child development is influenced by individual and dyadic parent-child factors, whereby behaviours and responses from both the parent and child influence each other and contribute to the quality of parent-child interactions (Bronfenbrenner, 1977; Harrison et al., 2011). It has been well established that the quality of dyadic parent-child interactions fosters all aspects of development, including cognitive (e.g., Kochanska, Murray, & Harlan, 2000) and socio-emotional skills (e.g., Cooke, Stuart-Parrigon, Movahed-Abtahi, Koehn, & Kerns, 2016; Kochanska, Forman, Aksan, & Dunbar,

2005), although this has not yet been examined extensively in relation to physical weight gain development (Bergmeier, Skouteris, & Hetherington, 2014; Blewitt, Bergmeier, Macdonald, Olsson, & Skouteris, 2016).

Despite the acknowledged importance of investigating dyadic parent-child interactions with regards to feeding, the vast majority of research evaluating parental and child influences of childhood overweight and obesity has adopted a uni-directional perspective, mainly assessing the influence of the parent on the child (Bergmeier, Skouteris, & Hetherington, 2014; Skouteris et al., 2011). For example, extensive research efforts have been focused on assessing the associations that parent child feeding practices have with child eating and weight (Faith, Scanlon, Birch, Francis, & Sherry, 2004; Jansen, Daniels, & Nicholson, 2012; Shloim, Edelson, Martin, & Hetherington, 2015), largely overlooking the influence that the child contributes toward parent-child feeding interactions. Research into parent child feeding practices across different cultures (e.g., Geng et al., 2009; Liu, Mallan, Mihrshahi, & Daniels, 2014; Nowicka, Sorjonen, Pietrobelli, Flodmark, & Faith, 2014; Schmidt et al., 2017; Tovar et al., 2012), has generally indicated that parental excessive use of control to moderate child food intake is associated with child eating (e.g., Birch, Fisher, & Davison, 2003) and weight status (e.g., Blissett & Bennett, 2013; Faith et al., 2004). Furthermore, it appears that parent child feeding practices may be performed in response to, rather than influence, child eating and weight status (e.g., Afonso et al., 2016; Rhee et al., 2009; Shloim et al., 2015). However, very few studies have attempted to include the dyadic influences between the child and the parent (Afonso et al., 2016; Anderson, Lemeshow, & Whitaker, 2014; Bergmeier et al., 2016; Bergmeier, Skouteris, & Hetherington, 2014). Furthermore, feeding practices, as measured by self-reports from parents and independent observations, are not always aligned (Bergmeier, Skouteris, Haycraft, Haines, & Hooley, 2015; Farrow, Blissett, & Haycraft, 2011; Lewis & Worobey, 2011); this may be because self-reports capture general feeding practices used to guide child eating (e.g., parental ideals and intentions relating to the use of practices to guide child eating), whereas observations are more likely to reveal variability in the execution of parent feeding practices when dyadic parent-child feeding interactional behaviours and responses are at play during the specific observed mealtimes (Bergmeier, Skouteris, Haycraft, Haines, & Hooley, 2015; Bergmeier et al., 2017).

Evaluations to date, either self-reported or independently observed, have not fully considered dyadic parent and child factors associated with child eating that are specific to the food-related context (e.g., Bergmeier et al., 2015; Farrow, Blissett, & Haycraft, 2011; Haycraft, Karasouli, & Meyer, 2017; Lewis & Worobey, 2011). To date, the few studies that have implemented dyadic parent-child measures reveal that parent-child dyadic behaviours during food-related interactions *and* the emotional quality of their relationship (i.e., trusting, sensitive and responsive to each other's needs) are both important to understanding developmental pathways to childhood eating behaviours and obesity risk (Bergmeier, Skouteris, & Hetherington, 2014; Blewitt et al., 2016). In order to advance our understanding of early pathways to obesity risk, we must address the paucity of research that considers the role that dyadic parent-child factors play in the development of child eating and weight.

In this paper we aim to address this gap by proposing a conceptual model of *Early Mother-Child Dyadic Pathways Influencing Childhood Obesity Risk* (Figure 1), which places parent-child relationships in a central role in understanding pathways that lead from parent-child feeding interactions to child body mass index (BMI). Contributors to childhood obesity development involve a complex interplay between multiple factors, including biology and society. The predominant focus of the model is on the interrelationships between the psychosocial factors that are modifiable from infancy and hence potentially responsive to intervention; the model incorporates principles stemming from Ecological Systems Theory (Bronfenbrenner, 1977; Harrison et al., 2011). Our model focuses on mother-child factors because mothers are typically the primary caregiver responsible for child feeding during preschool years (e.g., Haycraft et al., 2017); however, we ackowledge that fathers, co-parents and other caregivers also play a significant role in shaping child development.

In the following subsections we outline the theory and empirical findings that have informed the hypothesised pathways shown in the conceptual model. Each box presented in Figure 1 is summarised as it appears sequentially in the model.

Individual and dyadic parent-child factors associated with parent-child feeding interactions

Ecological Systems Theory highlights that there are particular child, parent and dyadic factors that influence child development (Bronfenbrenner, 1977), and potentially parent-child feeding interactions (Harrison et al., 2011). They include attachment security, child temperament and maternal mental health:

Attachment security.

The foundations of early parent-child relationship quality are built on the child's early attachment to their parent (Ainsworth, Blehar, Waters, & Wall, 1978; Bowlby & Base, 1988; Cassidy, Jones, & Shaver, 2013). According to attachment theory and research, attachment security is formed through sensitive and responsive interactions with caregivers (Ainsworth, Blehar, Waters, & Wall, 1978; Ainsworth, 1979; Cassidy et al., 2013). In order to provide responsive and sensitive caregiving, mothers need to be attuned to their infants' emotional states and needs (Feldman, 2007). Infants who have formed expectations that they will consistently receive responsive and sensitive caregiving are able to utilise their mother as a "secure base", from where they can explore their world, knowing that their mothers will be accessible and responsive when needed; children demonstrating these kinds of attachment behaviours (i.e., utilizing their mother as a secure base) are considered to be securely attached (Ainsworth, Blehar, Waters, & Wall, 1978; Ainsworth, 1979). Attachment theory proposes that maternal behaviours and responses that are attuned with infants' emotional states and needs, particularly during times of fear and/or distress, help co-regulate children's responses to these physiological and emotional reactions (Feldman, 2007; Leclère et al., 2014). The co-regulation of children's responses appears to support the maturation of children's brain structures involved in developing their own self-regulatory processes (Anderson & Keim, 2016; Vohs & Baumeister, 2016). In contrast, children who receive inconsistent, unresponsive, insensitive, harsh or indifferent caregiving are unable to form

expectations that they will receive comfort and reassurance when needed and may become insecurely attached (Ainsworth, Blehar, Waters, & Wall, 1978; Ainsworth, 1979). Mothers of children with insecure attachments do not demonstrate the attunement needed to co-regulate their infants; thus children with insure attachments tend to experience higher levels of stress, which comprises neurophysiological structures involved in supporting optimal self-regulation development (Cassidy et al., 2013; Vohs & Baumeister, 2016). Hence, caregivers' attunement to their child's cues (i.e., behaviours and emotions) during infancy and toddlerhood is particularly important in promoting higher quality dyadic parent-child interactions (Leclère et al., 2014), which contribute toward the establishment of child attachment security (Ainsworth & Tracy, 1972; Ainsworth, 1979; Feldman, 2007; Santona et al., 2015).

We now have emerging evidence uncovering the important role that parent-child attachment relationships play in childhood obesity development (Anderson & Keim, 2016), with longitudinal studies showing insecure attachment (arising from unresponsive, insensitive caregiving) is associated with higher obesity risk during preschool years and in adolescence (Anderson & Keim, 2016; Blewitt et al., 2016). For example, in a large national sample of US children, in which attachment security was assessed by observation when children were 24-months-old, the toddlers who were least securely attached (lowest quartile) to their mothers had a 30% higher risk of obesity at 4.5 years of age, compared to their peers who had been more securely attached as toddlers (Anderson & Whitaker, 2011). In another longitudinal study of 997 mother-child dyads expanding on this work, Anderson and colleagues (2012) found poor quality of mother-child relationship at 15, 24 and 36 months of age (i.e., low levels of maternal sensitivity at all time points and attachment insecurity at 24 months) was associated with obesity prevalence in adolescence. Child self-regulation, stemming from compromised dyadic parent-child interactions, has been proposed as a potential mechanism linking associations between attachment insecurity and obesity risk (Anderson & Keim, 2016; Anderson & Whitaker, 2011; Cassidy et al., 2013; Miller, Rosenblum, Retzloff, & Lumeng, 2016; Schwartz et al., 2011); the potential role of self-regulation in childhood overweight and obesity development is described in the Self-regulation section below. Individual child (i.e., temperament) (Clark, Kochanska, & Ready, 2000; Kiff, Lengua, & Zalewski, 2011) and maternal (i.e., mental health) (Martins & Gaffan, 2000; Milgrom & Holt, 2014) factors contribute to the nature and quality of parent-child interactions influencing the establishment of child security (e.g., Van den Boom, 1994).

Child temperament.

Temperament refers to the relatively enduring biological differences in reactivity and self-regulation that are influenced over time by heredity, maturation and experience (Rothbart, Ahadi, & Evans, 2000). These constitutionally derived differences influence an individual's emotional nature, attention and inhibitory control. Thus, temperament plays a potential role in shaping the nature and quality of parent-child interactions (Kiff et al., 2011). For example, a child temperament perceived as "difficult" combined with low parenting efficacy (which is more likely in mothers experiencing mental health issues) may result in dysfunctional parent-child interactions (Van den Boom, 1994). Furthermore, research shows that different child temperament dimensions are associated with specific eating behaviours (Bergmeier,

Skouteris, Horwood, Hooley, & Richardson, 2014). For example, preschool-age children with higher surgency (characterised by impulsivity, intense pleasure seeking, high activity level and low levels of shyness) are more likely to overeat in the absence of hunger, derive pleasure from food and eat in response to external cues, whereas children with higher negative affectivity (characterised by mood instability, angry reactivity and dysregulated negative emotions) are more likely to have tantrums over being denied food and less likely to eat in the absence of hunger (Leung et al., 2014). Recent research shows infants with higher negative reactivity are more motivated to perform laboratory tasks (i.e., push a button) by favourite food reinforcements than non-food reinforcements (children's video, bubbles and music) (e.g., Kong et al., 2016). Children and adults with higher weight status have been shown to find food highly reinforcing and consume more energy compared to those with lower weight status (e.g., Temple, Legierski, Giacomelli, Salvy, & Epstein, 2008). It is possible that parental behaviours may contribute to the development of food reinforcement in children with certain temperaments through parent-child feeding interactions involving the use of food to comfort infants who are perceived as being more difficult to soothe, such as those with higher negative reactivity (e.g., Agras, Hammer, McNicholas, & Kraemer, 2004; McMeekin et al., 2013). Indeed, other research (e.g., Wu, Dixon, Dalton, Tudiver, & Liu, 2011) indicates that temperament is a child characteristic that exerts influence on the nature and quality of parent-child feeding interactions and there is some evidence for a combined effect of low quality parent-child interactions in infancy (measured at 6 months of age) and child "difficult" temperament increasing risk for child obesity in grade six (~11–12 years).

Maternal mental health.

Maternal mental health has been implicated in lower-quality parent-child interactions, influencing the establishment of child attachment insecurity during the first year of life (Broth, Goodman, Hall, & Raynor, 2004; Martins & Gaffan, 2000). More specifically, poor mental health has been shown to interfere with maternal capacity to provide consistently responsive and sensitive caregiving (Broth et al., 2004; Nagata, Nagai, Sobajima, Ando, & Honjo, 2003). For instance, some mothers with depression may have difficulty differentiating between their own and their child's emotions, and thus fail to attune to these (e.g., Tronick, 2005). Further evidence shows mothers with depression can be less capable of communicating and sharing positive emotions and are more vulnerable to the distress of their infants (e.g., Beebe & Lachmann, 1988; Field, 2010). Other research has shown that, among other disengaged behaviours, mothers with depression gaze less at their infants, are emotionally flat and slower to respond to their child's needs (e.g., Feldman, 2007; Field, 2010). It has also been proposed that children's experiences of suboptimal interactions with their caregiver can influence the development of brain structures involved in setting their expectations relating to receiving care and subsequent establishment of attachment insecurity (Bowlby & Base, 1988; Cassidy et al., 2013).

Maternal mental health is also related to problematic feeding practices (e.g., (Santona et al., 2015), including excessive use of control (e.g., Farrow, 2005; Haycraft et al., 2008), missing child cues (e.g., Patel et al., 2002; Stein et al., 1994), and expressing more negative emotions and conflict (e.g., Patel et al., 2002) with their child in food-related situations compared to

non-food related interactions. For example, maternal depression has been positively associated with applying pressure to encourage daughters to eat (e.g., Haycraft & Blissett, 2008) as well as restricting food intake (e.g., Francis, Hofer, & Birch, 2001) during preschool years. Maternal anxiety has been shown to predict restriction of food intake in toddlerhood (e.g., Farrow & Blissett, 2005) and preschool years (e.g., Mitchell, Brennan, Hayes, & Miles, 2009). Maternal eating psychopathology has mainly been linked with use of restriction (e.g., Jackie Blissett & Haycraft, 2011) but has also been associated with use of the pressure to eat (e.g., Jackie Blissett & Haycraft, 2011; McPhie et al., 2014). It is possible that mothers' individual experiences of mental health symptoms (e.g., low mood; agitation) and their flow on effect on parent feeding (e.g., capacity to be attuned with child cues; anxious around food; concerned about weight) may influence the type of controlling feeding practice executed (McPhie et al., 2014; Mitchell et al., 2009; Stein et al., 1994). Both types of excessive use of parental child feeding control have been implicated in the development of children's problematic eating behaviours (Mitchell et al., 2013). Observational research has shown that children prompted to eat more tend to consume more mouthfuls than they would have unprompted (e.g., Orrell-Valente et al., 2007); when considered alongside child eating literature, this finding suggests parents using excessive control to prompt child eating may be socializing children to override innate satiety cues (e.g., Mitchell et al., 2013; Orrell-Valente et al., 2007; Schwartz et al., 2011). On the other hand, it has been proposed that parental use of control to restrict food intake may increase children's desire and intake of the particular type of restricted food and there is some research to support this theory (e.g., Birch et al., 2003; Rodgers et al., 2013); although evidence relating to restriction has been mixed, possibly due to: restrictive feeding practices being more difficult to observe as parents may restrict food intake through controlling the home food environment (e.g., Afonso et al., 2016; Bergmeier et al., 2017); conceptual challenges relating to the way parents report practices designed to moderate children's food intake (i.e, restriction vs limit setting) (Rollins, Savage, Fisher, & Birch, 2016); or in some younger children, restriction may be protective against unhealthful weight gain (e.g., Campbell et al., 2010).

Ecological Systems Theory and Attachment theory recognize that the foundational aspects of parent-child relationships established during infancy have enduring influences on long-term child development. Therefore, our model proposes that individual and dyadic factors during infancy will be associated with mother-child feeding interaction patterns emerging in infancy and continuing through to toddlerhood. Theoretically, child attachment security and temperament are stable traits (Ainsworth, Blehar, Waters, & Wall, 1978; Rothbart et al., 2000). Therefore, our model accounts for potential changes in maternal mental health across time points; cross-sectional (in infancy and toddlerhood) and longitudinal associations between maternal mental health (in infancy) and the quality of parent-child feeding interactions (in toddlerhood).

Establishment of early parent-child feeding interactions

As children transition to solids and are being socialized to become independent eaters, parent-child feeding interaction patterns emerge, revealing the Mutually Responsive Orientation in the dyadic feeding relationship. The Mutually Responsive Orientation of parent-child dyads is characterised by two main compoments: mutual parent-child

responsiveness and shared positive affect (Kochanska, 2002). The degree of mutual reciprocity and responsiveness within the dyad appears to be an important component distinguishing dyads experiencing smooth-flowing, cooperative parent-child interactions from parent-child relationships that develop along an adversarial developmental path (Aksan, Kochanska, & Ortmann, 2006; Kochanska, 2002). Cross-sectional and longitudinal research has shown that these types of positive daydic parent-child interactions foster preschoolers' socialisation of desirable attitudes and behaviours in other areas of child develpoment, including conscience and self-regulation (e.g., Kochanska, 2002; Kochanska & Aksan, 2006; Kochanska et al., 2005).

Preliminary research has demonstrated differences in Mutually Responsive Orientation in dyadic interactions across food and non-food related contexts (e.g., Bergmeier et al., 2016), highlighting the importance of understanding feeding-specific dyadic interactions to identify potentially problematic behaviours and responses that might contribute to unhealthy weight gain. Importantly, this research has shown that Mutually Responsive Orientation during food-related exchanges can reduce the frequency and severity of mealtime conflict (typically associated with the development and maintenance of feeding problems) and promote the child's willingness to internalise the parent's food attitudes and behaviours (Bergmeier et al., 2016; Mitchell et al., 2013). In line with previous studies investigating Mutually Responsive Orientation in non food-related contexts (e.g., Kochanska et al., 2005), findings from research examining preschoolers' mealtimes highlighted that Mutually Responsive Orientation in mother-child dyads is consistent over time (e.g., Bergmeier et al., 2016; Kochanska et al., 2005). Based on these findings, our model shows that Mutually Responsive Orientation patterns that are identified in infancy will predict the Mutually Responsive Orientation of parent-child interactions in toddlerhood (Figure 1).

Child self-regulation and eating behaviours

Self-regulation is defined as a multidimensional construct that encompasses the conscious and unconscious neurocognitive processes by which individuals manage and regulate their attention and arousal in order to engage in goal-directed behavior (Calkins, 2007). Decades of child development research shows that positive parent-child relationships support the development of child self-regulation (e.g., Anderson & Keim, 2016; Caleza, Yañez-Vico, Mendoza, & Iglesias-Linares, 2016). As discussed earlier, parent-child interactions that contribute to establishing child attachment security promote optimal development of children's neurophysiological systems (Cassidy et al., 2013), such as those involved in responses to stress, sleep and appetite, and long-term ability to self-regulate (e.g., Anderson & Keim, 2016; Evans, Fuller-Rowell, & Doan, 2012; Shonkoff, Boyce, & McEwen, 2009; Stoeckel et al., 2017).

Evidence suggests low capacity for self-regulation is a potential risk for developing obesity within and outside of food contexts (e.g., Caleza et al., 2016; Piché, Fitzpatrick, & Pagani, 2012; Stoeckel et al., 2017), but few studies have investigated this link in preschool-aged children (Miller et al., 2016). One such study, conducted by Miller and colleagues (2016), involved observations of 133 33-month old children. They found better behavioural self-regulation was associated with lower weight status and obesity risk in food delay (ability to

wait) tasks but not in non-food tasks. In contrast, better emotional self-regulation (task designed to elicit frustration, demonstrated by negative reactivity) in food tasks was associated with lower weight status and in non-food tasks was associated with lower obesity risk (Miller et al., 2016).

Child self-regulation and eating behavior that contribute toward childhood overweight and obesity are shaped early in life (Connell & Francis, 2014; Kochanska & Aksan, 2006; Miller et al., 2016), through biological and external (i.e., parenting) influences (e.g., Anderson & Keim, 2016; Anzman-Frasca et al., 2013; Connell & Francis, 2014; Evans et al., 2012; Vohs & Baumeister, 2016). Current research shows that those with lower self-regulation are believed to be less sensitive to internal hunger and fullness cues and less able to regulate consumption if there are external (i.e., highly palatable food) cues present (e.g., Frankel et al., 2012). Other research suggests that those with lower self-regulation may learn from a young age to use food to deal with negative emotions (e.g., Braden et al., 2014) or be more responsive to brain reward systems activated by food consumption (e.g., Agras et al., 2004; Anzman-Frasca et al., 2013; Stoeckel et al., 2017). Contributors to the development of self-regulation processes associated with eating behavior and obesity risk are multifactorial (Caleza et al., 2016; Calkins, 2007; Mittal, Russell, Britner, & Peake, 2013); therefore identifying its modifiable early influences is paramount to preventing the establishment of potentially problematic child eating behavior patterns (Stoeckel et al., 2017).

Children experience marked increases in behavioural and self-regulatory development throughout toddlerhood (Kochanska et al., 2000; Mittal et al., 2013). Given Mutually Responsive Orientation has been shown to predict child self-regulation in other contexts, the model predicts that the Mutually Responsive Orientation of dyadic parent-child feeding interactions in infancy, and continued to toddlerhood, will influence child self-regulation in toddlerhood and that child self-regulation will be associated with child eating behaviours in toddlerhood.

Further directions and implications for obesity prevention

Given the theoretical and empirical advances highlighting the important role of the parent-child relationship in fostering optimal child eating behaviours and weight gain, understanding modifiable early dyadic mother-child pathways to childhood obesity risk is crucial. Despite recent progress, it is clear that knowledge of the various pathways linking parent-child interactions with child eating- and weight-related outcomes remains rudimentary. This could be partly due to the disconnect between multiple disciplinary fields working toward unpacking each piece of the complex childhood obesity puzzle. It is essential that these ‘research silos’ are broken down so that our understanding of these complex factors can deepen. It may also be due to the fact that few studies have implemented appropriate methodologies for providing causal evidence for the effects of parent and child factors influencing the *nature* and *quality* of early parent-child relationships and interactions implicated in obesity risk (Bergmeier et al., 2016; Bergmeier, Skouteris, & Hetherington, 2014; Blewitt et al., 2016).

The proposed model bridges the gap between research fields by bringing together key maternal and child dyadic factors implicated in child development. We acknowledge that the causes of childhood obesity development are multifactorial and complex (Harrison et al., 2011). Indeed, Ecological Systems Theory posits that the family context is embedded within broader social-cultural factors (Bronfenbrenner, 1977). For example, parent feeding practices and parent feeding styles have been shown to differ across ethnic (e.g., Cardel et al., 2012), racial (e.g., Blissett & Bennett, 2013) and socio economically diverse populations (e.g., Cardel et al., 2012). Furthermore, parental attitudes relating to how they view children's body size (thus potentially influencing feeding practices) appear to be culturally defined (Kumanyika, 2008). We also note that there are other potential mediating factors linking early mother-child dyadic pathways to obesity risk that are not detailed in our model, including maternal weight status (Haire-Joshu & Tabak, 2016) and alternate physiological mechanisms associated with lower self-regulation (e.g., effect of stress response on increasing appetite and reducing energy expenditure e.g., Dallman et al., 2003; Evans et al., 2010). However, they have not been addressed as they are beyond the scope of the paper's focus on outlining potential modifiable psychosocial factors in early childhood.

Consideration of the factors outlined in the proposed model will generate knowledge needed to progress the science for building reliable risk and protective profiles of child eating behaviours for informing family-based obesity prevention strategies. High quality quantitative and observational data capturing meaningful parent, child and dyadic level interactions around food contexts, attachment security, maternal mental health, child temperament and self-regulation is needed to test the proposed pathways.

Abbreviations:

BMI	Body Mass Index
WHO	World Health Organization

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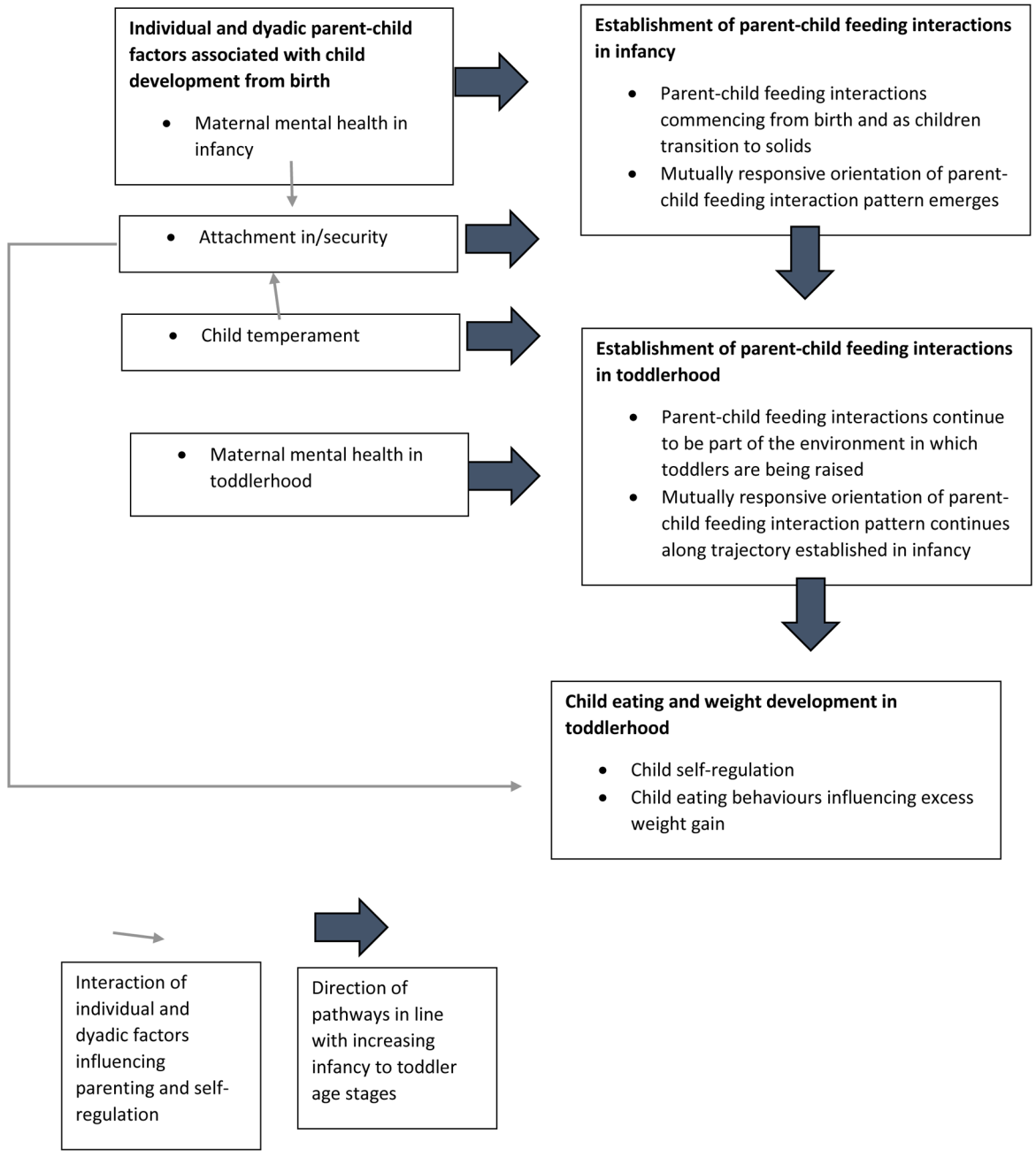

Figure 1.
The Early Mother-Child Dyadic Pathways Influencing Childhood Obesity Risk conceptual model.