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Maternal body dissatisfaction in pregnancy, postpartum and early parenting: An overlooked factor implicated in maternal and childhood obesity risk

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Abstract

Background: Current evidence indicates that to prevent the intergenerational transfer of overweight and obesity from parent to child, interventions are needed across the early life stages, from preconception to early childhood. Maternal body image is an important but often overlooked factor that is potentially implicated in both short- and long-term maternal and child health outcomes, including maternal gestational weight gain, postpartum weight retention, obesity, child feeding practices and early parenting.

Aim: The aim of this paper is to propose a conceptual model of the relationship between maternal body image (with a specific focus on body dissatisfaction) and maternal and child excess body weight risk across the pregnancy, postpartum and early childhood periods, as well as to highlight opportunities for intervention.

Conclusion: Our conceptual model proposes factors that mediate the associations between antenatal and postpartum maternal body dissatisfaction and maternal and childhood obesity risk. Pregnancy and postpartum present key risk periods for excess weight gain/retention and body dissatisfaction. Psychosocial factors associated with maternal body dissatisfaction, including psychopathology and disordered eating behaviours, may increase maternal and child obesity risk as well as compromise the quality of mother-child interactions underpinning child development outcomes, including physical weight gain. Our conceptual model may be useful for understanding modifiable psychosocial factors for preventing the intergenerational transfer of obesity risk from mothers to their children, from as early as pregnancy, and highlights next steps for multidisciplinary research focused on combatting maternal and child obesity during critical risk periods.

Key words: Gestational weight gain (GWG); Postpartum weight retention (PPWR);

Obesity; Child feeding practices; Parenting; Body image.

Introduction

There is global consensus that the burden of maternal and childhood obesity needs to be reduced urgently (Poston et al., 2016; World Health Organization [WHO], 2016). Maternal obesity is associated with increased risk of chronic diseases and adverse pregnancy outcomes (Enomoto et al., 2016; McIntyre, Gibbons, Flenady, & Callaway, 2012; Ovesen, Rasmussen, & Kesmodel, 2011; Poston et al., 2016; Saben et al., 2016; Yu et al., 2013; Zhang, Wu, Li, & Zhang, 2018). In addition, maternal obesity increases the risk of obesity in offspring through epigenetic effects on gene expression that take place during pregnancy (Saben et al., 2016; Turner & Robker, 2014), as well as via behavioural influences postpartum (Haire-Joshu & Tabak, 2016; Lane, Zander-Fox, Robker, & McPherson, 2015; Reichetzeder, Putra, Li, & Hoher, 2016), including parent-child relationship quality and feeding interactions (Anderson & Keim, 2016; Calkins, 2007; Evans, Fuller-Rowell, & Doan, 2012; Haire-Joshu & Tabak, 2016; Harrison et al., 2011; Lane et al., 2015; Lindsay, Greaney, Wallington, Mesa, & Salas, 2017; Reichetzeder et al., 2016; Turner & Robker, 2014).

Compounding the issue is the fact that the majority of adults worldwide have overweight or obesity, with reproductive-aged women leading this trend, gaining weight more rapidly than men and older women (Goldstein et al., 2017; Lim et al., 2019; Poston et al., 2016; Teede et al., 2013). Evidence indicates that to prevent the intergenerational transfer of obesity, interventions targeting preconception to early childhood are needed (Haire-Joshu & Tabak, 2016; Schack-Nielsen, Michaelsen, Gamborg, Mortensen, & Sørensen, 2010). Currently most researchers work in silos – either in the area of maternal obesity during the perinatal period, childhood obesity, children’s eating behaviour or appetite. Bridging disciplines and life stages for the prevention of obesity is needed to progress this field of science effectively and to reduce

the prevalence of obesity and overweight.

Obesity risk is established early in life through a complex interplay of genetic and environmental factors, including parental actions and parent-child interactions involving biological and behavioural processes (Anderson & Keim, 2016; Bergmeier, Skouteris, & Hetherington, 2014; Calkins, 2007; Haire-Joshu & Tabak, 2016; Harrison et al., 2011; Kumanyika, 2008). To date, much of the literature investigating links between maternal and early childhood obesity risk has focused on biological (e.g., genetic; epigenetics e.g., Saben et al., 2016) and lifestyle (e.g., dietary e.g., Ho et al., 2012; Lane et al., 2015) factors. However, less attention has been paid to understanding how maternal psychological factors during pregnancy and the postpartum period might interact with these biological and lifestyle factors to increase the risk of excess body weight for mothers and their offspring.

Maternal body image is one of these important, but often overlooked, psychological factors implicated in the development of maternal excess body weight during pregnancy (e.g., Andrews, Hill, & Skouteris, 2018; Hill, Skouteris, McCabe, & Fuller-Tyszkiewicz, 2013; Hill, Skouteris, McCabe, Milgrom, et al., 2013) and postpartum (e.g., Clark, Skouteris, Wertheim, Paxton, & Milgrom, 2009b; Morin, 1995; Morin, Brogan, & Flavin, 2002; Phillips, King, & Skouteris, 2012). In turn, maternal excess weight significantly increases offspring's obesity risk via epigenetic effects in utero (Saben et al., 2016; Turner & Robker, 2014). In the postpartum period, associations between maternal body image and excess weight gain/retention may contribute to the development of potentially problematic parent-child feeding interactions and practices in early childhood (Haire-Joshu & Tabak, 2016; Hauff & Demerath, 2012; Webb & Haycraft, 2019) that may compromise children's ability to

engage with satiety cues (e.g., Birch, Fisher, & Davison, 2003) and thereby promote obesity risk (e.g., Afonso et al., 2016; Graziano, Calkins, & Keane, 2010).

Body image is a complex construct comprising internal representations of one's appearance, involving perceptual, cognitive and affective aspects of body experience (Cash & Pruzinsky, 2002; Cash & Pruzinsky, 1990). Body dissatisfaction is one facet of body image and refers to negative subjective evaluations of one's own body size and shape, arising when there is a discrepancy between one's own body image and ideals (Stice & Shaw, 2002; Thompson, Heinberg, Altabe, & Tantleff-Dunn, 1999). Body dissatisfaction has been linked with depressive symptoms (e.g., Pimenta, Sánchez-Villegas, Bes-Rastrollo, López, & Martínez-González, 2009; Roomruangwong, Kanchanatawan, Sirivichayakul, & Maes, 2017), dangerous dieting behaviours and eating disorders including bulimic pathology (e.g., Neumark-Sztainer, Paxton, Hannan, Haines, & Story, 2006; Mond et al., 2013; Pimenta et al., 2009; Silva, Nahas, de Sousa, Del Duca, & Peres, 2011; Stice & Shaw, 2002; van den Berg, Wertheim, Thompson, & Paxton, 2002). Maternal body dissatisfaction has also been associated with excess gestational weight gain (GWG) (e.g., Clark et al., 2009b; Hill, Skouteris, McCabe, & Fuller-Tyszkiewicz, 2013; Mehta, Siega-Riz, & Herring, 2011; Skouteris, 2012) and postpartum weight retention (PPWR) (e.g., Clark et al., 2009b; Mehta et al., 2011; Morin et al., 2002; Phillips et al., 2012), placing women who have had children at greater risk of long-term excess body weight (Amorim, 2007; Linne, Dye, Barkeling, & Rössner, 2003; Linne, Dye, Barkeling, & Rössner, 2004; Rooney, Schauburger, & Mathiason, 2005).

The potential negative impact that maternal body dissatisfaction can have on mothers' mental health (i.e., depression) and/or unhealthful eating behaviour (i.e., binge eating) may reduce her engagement in practices, such as breastfeeding, that assist to

combat excess body weight (e.g., de Jager, Skouteris, Broadbent, Amir, & Mellor, 2013; Goldschmidt et al., 2014; Hauff & Demerath, 2012; Stice & Shaw, 2002; Torgersen et al., 2010). In turn, associations between maternal body image and factors implicated in health behaviour (i.e., mental health symptoms; disordered eating patterns) may influence the quality of early parent-child interactions, including potentially problematic child feeding practices (e.g., Bergmeier et al., 2016; Farrow & Blissett, 2005; Haire-Joshu & Tabak, 2016; McPhie, Skouteris, Daniels, & Jansen, 2014; Stang & Loth, 2011; Webb & Haycraft, 2019). Problematic parent-child interactions have been implicated in promoting childhood obesity risk (e.g., Anderson, Lemeshow, & Whitaker, 2014).

Pregnancy and the postpartum period present unique opportunities that increase women's risks for experiencing body dissatisfaction and associated maladaptive cognitions, such as depression and anxiety, and disordered eating behaviours (Clark et al., 2009b; Skouteris, 2012). The association between maternal body dissatisfaction and depression is particularly concerning because depression during pregnancy is a strong predictor of postnatal depression (Beck, 2001), which in turn has been associated with compromised child development, including social (e.g., Carter, Garrity-Rokous, Chazan-Cohen, Little, & Briggs-Gowan, 2001) and cognitive deficits (e.g., Koutra et al., 2013). A negative maternal body image has also been associated with poorer mother-fetal attachment quality (Huang, Wang, & Chen, 2004) and lower breastfeeding intention during pregnancy (e.g., Barnes, Stein, Smith, Pollock, 1997). Despite this evidence, screening for body image concerns is not part of routine obstetric care, which means that a key opportunity for health professionals to intervene to reduce maternal and child risk factors is missed. This may be due to the fact that: 1) our understanding of the relationships between maternal body image and weight during pregnancy and the

postpartum period is still a growing area of research (Hill, Skouteris, McCabe, Milgrom, et al., 2013); and 2) evidence of mechanisms linking early parent-child interactions and child weight is lacking (Anderson & Keim, 2016; Bergmeier et al., 2016).

Ecological Systems Theory posits that individual and dyadic mother-child factors (i.e., child attachment, child temperament and maternal psychological factors) influence child development, including physical weight gain (Anderson & Keim, 2016; Bergmeier, Skouteris, Horwood, Hooley, & Richardson, 2014; Bronfenbrenner, 1977; Harrison et al., 2011; McPhie et al., 2014). This assertion is supported by empirical evidence highlighting that these psychosocial factors influence the quality of early dyadic parent-child feeding interactions; in turn, the quality of early dyadic parent-child feeding interaction patterns influence the development of child self-regulation and eating behaviours implicated in child weight status (Anderson & Keim, 2016; Bergmeier, Skouteris, & Hetherington, 2014; McPhie et al., 2014). However, research to date has predominately focused on either unidirectional mother or child factors only; this has resulted in a critical gap in the literature concerning early pathways to obesity risk from a life-course perspective.

Hence, it is imperative we now address obesity prevention from a life-course perspective by bridging the gap between psychosocial factors linking maternal and child obesity risk, from as early as pregnancy, with a specific focus on maternal body image. The aim of this study was to extend previous work by proposing an ecological conceptual model (see Figure 1) of the relationship between maternal body dissatisfaction, and maternal and childhood overweight and obesity risk across pregnancy, postpartum and early childhood periods. We are focusing here on how maternal body image interacts with perinatal maternal weight gain/retention,

psychological wellbeing and eating behaviour, and early pathways to childhood obesity risk, beginning with early dyadic mother-child interactions to child weight status. We note that the causes of obesity are complex, extending from individual (including genetic) to community/societal factors (Harrison et al., 2011; Kumanyika, 2008). Our predominant focus is on the interrelationships between the psychosocial factors that are modifiable and hence potentially responsive to intervention.

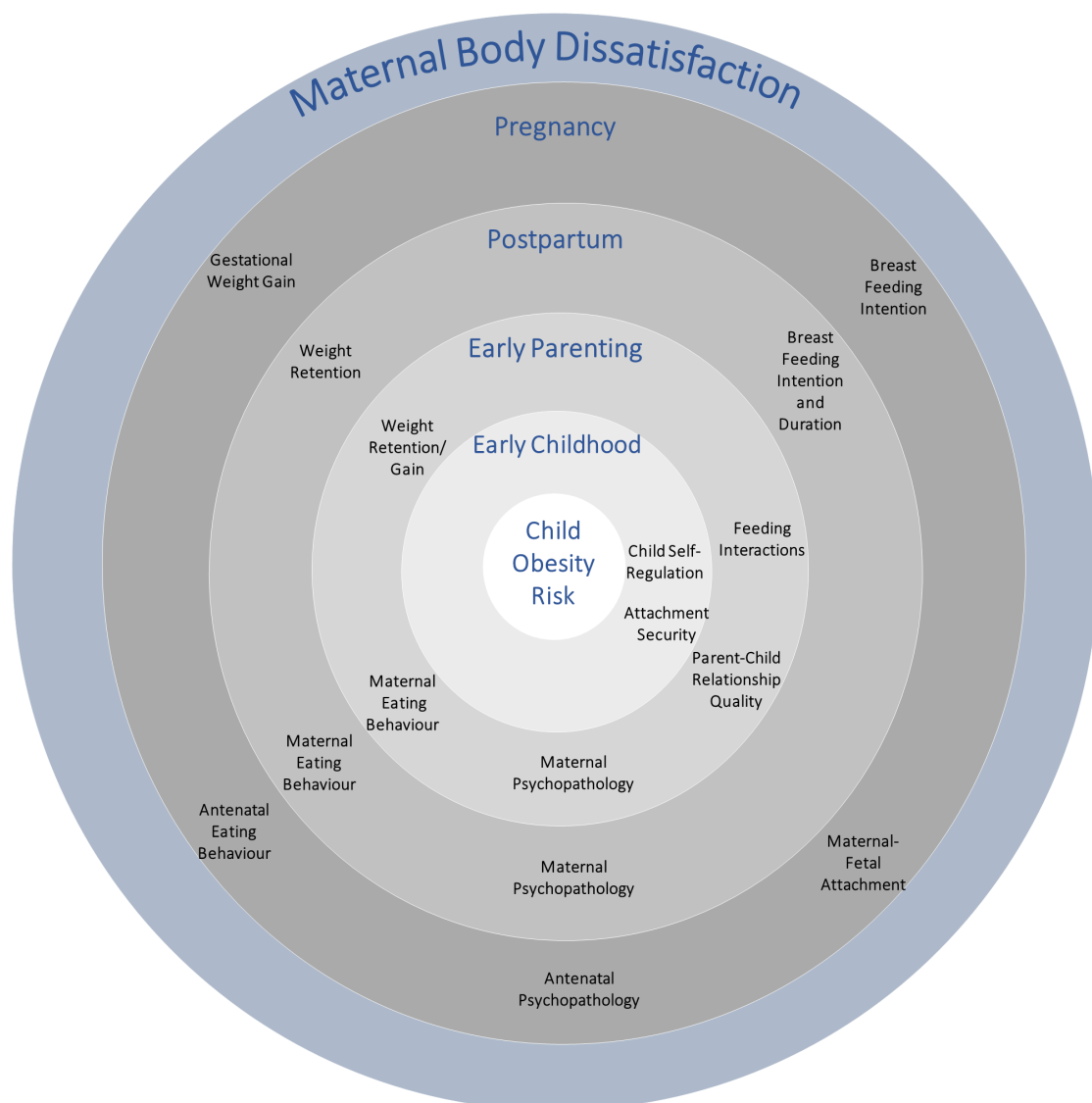


Figure 1. A conceptual model of maternal body dissatisfaction in pregnancy, postpartum and early parenting and its relationship with individual and dyadic mother-child factors associated with childhood obesity risk.

In the following subsections we outline the theory and empirical findings that have informed the relationships between maternal body image and individual and dyadic mother-child factors outlined in the proposed ecological conceptual model.

Body image during pregnancy

Pregnancy is a time when women's bodies undergo rapid changes in size and shape within a relatively short period of time (~40 weeks). It is also a unique period when social norms that would typically apply are often disregarded, with pregnant women reporting unwelcome comments on the size of their growing bodies and touching of certain body parts, namely the 'baby bump', adding increasing focus to these psychological and physiological adaptations (Skouteris, 2012). While for some women pregnancy may present a time of respite from societal expectations of ideal body types, research shows that many women experience body dissatisfaction during pregnancy (Clark et al., 2009b; Roomruangwong et al., 2017). Our model proposes that body dissatisfaction during pregnancy may increase maternal and childhood obesity risk through: 1) its association with antenatal maternal eating and weight, and 2) antenatal and postnatal psychosocial factors influencing the establishment of early mother-child relationship quality, including future parent-child feeding interactions, as outlined below.

Gestational weight gain. During pregnancy, body dissatisfaction has been noted among women with greater and lower pre-pregnancy BMI (e.g., Andrews et al., 2018; Huang et al., 2004); and higher levels of body dissatisfaction in pregnancy may be associated with increases in GWG (Hill, Skouteris, McCabe, & Fuller-Tyszkiewicz, 2013). Gestational weight gain in excess of the US Institute of Medicine (IOM) recommendations occurs in a large proportion of pregnancies in both the UK and

Australia and in other developed countries internationally, with 50% of women gaining more than the recommended weight (AIHW, 2018; Rasmussen & Yaktine, 2009; NSC, 2018). This has significant consequences with every kilogram above IOM recommendations increasing adverse maternal and fetal outcomes by approximately 10% (McIntyre et al., 2012; Rasmussen & Yaktine, 2009). In addition, excessive GWG increases maternal long-term weight and subsequent childhood weight 3-fold, independent of maternal pre-pregnancy BMI (Fraser et al., 2011; McIntyre et al., 2012). Direct implications of excess GWG for maternal and child obesity risk are described in the *Body image during the postpartum period* and *Body dissatisfaction and early parenting* sections.

Antenatal eating behaviour. Body dissatisfaction is associated with problematic dietary behaviours (i.e., disordered eating), posing severe additional health risks to both mother and baby (Micali, Al Essimii, Field, & Treasure, 2018; Stice & Shaw, 2002; Taborelli et al., 2016). Certain disordered eating behaviours, such as in the case of binge eating, may involve the overconsumption of low nutrient, energy dense food and may result in excess body weight (Micali et al., 2018). While few studies have investigated binge eating in pregnancy, it has been positively associated with GWG (e.g., Park et al., 2015). For example, a recent study by Micali and colleagues (2018) showed loss of control (a characteristic of binge eating) in pregnancy was common (36.3%). They reported that women with occasional and frequent loss of control in pregnancy had higher prevalence of dieting in pregnancy and being dissatisfied with their shape compared to women without loss of control (Micali et al., 2018). This study also revealed that women with loss of control in pregnancy had higher energy intake and gained 3.74 kg on average more weight than women without loss of control. Additionally, offspring of the mothers with frequent loss of control had 2-fold increased

odds of having overweight/obesity at 15 years of age. Over nutrition and excess GWG critically increase the child's likelihood of developing obesity in childhood and later in life through genetic and epigenetic effects (Haire-Joshu & Tabak, 2016; Lane et al., 2015).

Antenatal psychopathology, maternal-fetal attachment and breastfeeding intention.

Body dissatisfaction is associated consistently with symptoms of depression and anxiety in the general population (e.g., Roomruangwong et al., 2017). In addition to impacting maternal physical and emotional wellbeing, there is recent meta-analytic evidence linking antenatal depression and anxiety with difficulties in children's socio-emotional development, including temperament and self-regulation (Madigan et al., 2018). Both of these child factors have been associated with child eating behaviours implicated in increased child obesity risk (e.g., Agras, Hammer, McNicholas, & Kraemer, 2004; Anderson & Keim, 2016; Bergmeier, Skouteris, Horwood, et al., 2014; Graziano et al., 2010). Psychological aspects associated with maternal body dissatisfaction during pregnancy may have a cumulative influence on the promotion of childhood obesity risk by disrupting the quality of maternal-fetal attachment (i.e. the relationship between a woman and her fetus) (Brandon, Pitts, Denton, Stringer, & Evans, 2009; Huang et al., 2004; Koutra et al., 2013) and increasing the risk of postpartum depression (Alhusen, Hayat, & Gross, 2013; Brandon et al., 2009); each of these factors may subsequently interfere with the development of mother-child attachment after birth (Brandon et al., 2009), breastfeeding initiation and duration (de Jager et al., 2013), and with mother-child feeding interactions (Santona et al., 2015). Evidence suggests that suboptimal early parent-child relationship quality and problematic feeding interactions increase child obesity risk (e.g., Anderson & Keim, 2016; Bergmeier et al., 2016). These relationships between maternal psychosocial

factors, mother-child interactions and child feeding are described further in the *Body image during the postpartum period* and *Body dissatisfaction and early parenting* sections.

Based on the research findings presented above, our model indicates that body dissatisfaction during pregnancy may be associated with excess GWG and lower breastfeeding intention. It also suggests that maternal body dissatisfaction during pregnancy may be associated with maternal eating behaviour (e.g., disordered eating) and psychopathology (e.g., depression) and maternal psychopathology may be associated with lower maternal-fetal attachment during pregnancy.

Body image during the postpartum period

There is consistent evidence showing that in comparison to pre-pregnancy and late pregnancy, body image concerns become particularly salient in the postpartum period (from six months after birth) and progressively worsen over time (e.g., Clark et al., 2009b). This is likely to occur because women abandon more relaxed attitudes they may have held relating to body changes during pregnancy and the immediate postpartum phase and perceive that enough time has passed to regain their pre-pregnancy size and shape (Clark, Skouteris, Wertheim, Paxton, & Milgrom, 2009a). Furthermore, the postpartum recovery period can last up to six months (Romano et al., 2010), hence, at six months and beyond, women may: 1) be less likely to view their bodies as a shared entity for nurturing offspring following changes to breastfeeding behaviour; 2) no longer have reasons to avoid engaging in healthy lifestyle behaviours that may assist with postpartum weight loss (e.g., physical activity); and 3) recommence appraising their body size and shape with the pre-pregnancy expectations they held as individuals. Our model shows that factors associated with body dissatisfaction during

pregnancy continue to influence the establishment of individual and dyadic mother-child obesity risk factors postpartum, as outlined below.

Postpartum weight retention (PPWR): Pregnancy and the first year postpartum have been identified as crucial risk periods for women gaining and retaining long-term excess body weight (NICE, 2010). It is well established that GWG is a powerful predictor of PPWR (e.g., Huang, Wang, & Dai, 2010; Siega-Riz et al., 2010). As noted earlier, more than 50% of women exceed IOM GWG guidelines (Rasmussen & Yaktine, 2009), heightening their risk for excess long-term body weight. While determinants of higher PPWR are multifactorial, it is clear that modifiable psychological factors, including body dissatisfaction (Hollis et al., 2017), play a significant role in women's postpartum weight status and longer term weight retention (Phillips et al., 2012).

Maternal psychopathology and early parent-child relationship quality. Depressive symptoms experienced during pregnancy have been shown to be associated with body dissatisfaction in pregnancy and postpartum (e.g., Clark et al., 2009b; Roomruangwong et al., 2017), and this relationship appears to be stronger for some women during the postpartum period than during pregnancy (e.g., Clark et al., 2009b). Maternal psychopathology in the postpartum period has a number of implications for maternal and child obesity risk. Psychopathology can restrict maternal capacity to engage in healthy lifestyle behaviours associated with promoting healthful weight status including motivation and eating behaviour (e.g., Appelhans et al., 2012; Treadway, Bossaller, Shelton, & Zald, 2012). With regard to child obesity risk, maternal psychopathology may limit mothers' emotional and behavioural contribution to establishing the kind of positive parent-child interactions that have been shown to foster

child attachment security (Ainsworth, Blehar, Waters & Wall, 1978; Bowlby & Base, 1988; Cassidy, Jones, & Shaver, 2013; Milgrom & Holt, 2014). It is well established that child attachment security promotes optimal child development, including higher self-regulation (Carter et al., 2001; Cassidy et al., 2013; Milgrom & Holt, 2014) and contributes toward healthful physical weight gain (Anderson & Keim, 2016; Bergmeier et al., 2016; Milgrom & Holt, 2014). The role that parent-child interactions play in the development of childhood obesity risk is described further in the *Body dissatisfaction and early parenting* section.

Breastfeeding initiation and duration. Research shows that women's likelihood or willingness to breastfeed is influenced by the degree of body image satisfaction both prior to, and during, pregnancy (e.g., Barnes et al., 1997; de Jager et al., 2013; Huang et al., 2004). Women with a pre-pregnancy overweight or obese BMI classification have also been shown to breastfeed for shorter durations compared to women of healthy BMI status and this relationship appears to be mediated by body image concerns (e.g., Hauff & Demerath, 2012). Furthermore, postpartum body dissatisfaction is associated with a lower likelihood of breastfeeding and higher postpartum weight retention (e.g., Phillips et al., 2012).

Maternal eating behaviour and early feeding interactions. Body dissatisfaction has been associated with maternal eating disturbances such as those involving bingeing (e.g., Micali et al., 2018; Stice & Shaw, 2002); excess body weight is a common outcome of these types of disordered eating behaviours (Micali et al., 2018). Women with prior histories of eating disturbances appear to be particularly vulnerable to experiencing body dissatisfaction and eating disorder relapses during the postpartum period (e.g., Lemberg & Phillips, 1989; Taborcelli et al., 2016). Problematic dietary

behaviours have the potential to not only affect mother and baby (e.g., lower milk supply; Carwell & Spatz, 2011) but also make bonding and mother-infant feeding interactions more challenging (Carwell & Spatz, 2011; Patel, Wheatcroft, Park, & Stein, 2002). Women who engage in disordered eating behaviours (such as binge eating/diet-binge cycle) to compensate for their negative feelings about their body's size and shape are also less likely to breastfeed (e.g., Torgersen et al., 2010). Mothers with body dissatisfaction and/or eating disturbances additionally report finding feeding their children more challenging (Patel et al., 2002) and are more likely to engage in dysfunctional parent-child feeding interactions (Stein, Woolley, Cooper, & Fairburn, 1994), including using excessive control to moderate child eating (Blissett & Haycraft, 2011), being less attuned to child cues and experiencing more conflict, compared with non-food related activities (Patel et al., 2002; Santona et al., 2015; Stein et al., 1994).

Based on the research findings presented above, our model suggests that higher PPWR may be associated with higher maternal body dissatisfaction postpartum. Our model also indicates that higher maternal body dissatisfaction postpartum may be associated with maternal eating behaviours, which have been implicated in contributing to excess body weight (e.g., binge eating) and with lower breastfeeding initiation and retention. It also proposes that maternal psychopathology during pregnancy can influence postnatal maternal psychopathology, which in turn, may influence the continuance/emergence of compromised mother-child interactions.

Body dissatisfaction during early parenting/early childhood: relationships with maternal psychopathology, eating behaviour, weight gain and childhood obesity risk.

The relationships between body dissatisfaction and maternal factors, including

weight gain, eating behaviour and psychopathology, and the role they play in establishing the quality of parent-child interactions and feeding practices, have been highlighted from pregnancy to postpartum. These factors continue to influence child obesity risk during early parenting. Body dissatisfaction can increase childhood obesity risk beyond the postpartum phase through its continued influence on maternal psychopathology and the role that it plays in establishing the nature and quality of longer-term mother-child feeding interactions. Maternal psychopathology can interfere with behavioural and emotional interactions between mothers and their offspring, and these interactions subsequently influence the establishment of the child attachment relationship (secure vs. insecure) (Ainsworth et al., 1978; Milgrom & Holt, 2014). This is the critical point of transfer from maternal factors to childhood obesity risk.

Child attachment security and self-regulation. Child attachment security is formed through consistently sensitive and responsive caregiving (Ainsworth, 1979; Cassidy et al., 2013). In contrast, children who experience inconsistent, harsh, or indifferent caregiving tend to develop insecure attachments (Ainsworth & Tracy, 1972; Ainsworth, 1979). Psychopathology can potentially interfere with a mother's capacity to attune to her child's signals and provide consistently sensitive responses (Milgrom & Holt, 2014; Nagata, Nagai, Sobajima, Ando, & Honjo, 2003). A child's attachment to a parent/primary caregiver has been shown to predict a wide range of child development outcomes, including self-regulation (Anderson & Keim, 2016; Cassidy et al., 2013; Kochanska, Murray, & Harlan, 2000). Attachment theory and research evidence indicate that caregiving behaviours associated with establishing child attachment security, such as assisting to co-regulate the child during times of distress, promote the maturation of the child's brain structures involved in developing their own self-

regulation processes (Anderson & Keim, 2016; Calkins, 2007; Vohs & Baumeister, 2016).

More recently, child attachment insecurity has been linked with increased obesity risk in early childhood (e.g., Anderson & Keim, 2016) and adolescence (Blewitt, Bergmeier, Macdonald, Olsson, & Skouteris, 2016). For example, Anderson and Whitaker (2011) showed that children with insecure attachment at 24 months were at increased risk of obesity at 4.5 years of age; this association remained after accounting for mother-child interactions during play, feeding practices, maternal BMI and socio-demographic characteristics. Another study by Anderson and colleagues (2012) showed lower maternal sensitivity and child insecure attachment in early childhood (measured at 15, 24 and 36 months of age) was associated with increased odds of obesity at 15 years of age. Given that caregiving behaviours associated with establishing child attachment security promote the development of neurophysiological systems (Cassidy et al., 2013), including stress response, appetite and sleep (e.g., Anderson & Keim, 2016; Evans, Fuller-Rowell, & Doan, 2012; Shonkoff, Boyce, & McEwen, 2009; Stoeckel et al., 2017) and long-term ability to self-regulate, child obesity researchers have proposed that child self-regulation may be one of the pathways linking associations between child attachment security and obesity risk (Anderson & Keim, 2016).

Parent-child relationship quality, feeding interactions, self-regulation and childhood obesity risk. Anderson and Keim (2016) recently summarised evidence linking associations between parent-child relationship quality, self-regulation and weight status during childhood. They highlighted that the effect of suboptimal caregiving on the development of child self-regulation involves neurophysiological processes influencing

sleep, stress response and appetite, and proposed that these biological processes may underpin associations between parent-child relationship quality and childhood obesity risk (Dallman, 2010; McEwen, 2008; Torres & Nowson, 2007). It is also possible that those with a lower capacity to manage stress, due to lower self-regulation, may use food to deal with difficult emotions (Tomiya, Finch, & Cummings, 2015). For example, chronic stress has been linked with higher engagement in “comfort eating” (i.e., the consumption of highly palatable foods, typically comprising high fat and/or high sugar content), placing individuals at higher risk of gaining excess body weight (Finch & Tomiyama, 2015; Tomiyama et al., 2015). We also know that parent-child interactions (general and feeding) have the potential to reinforce child self-regulation processes (e.g., Connell & Francis, 2014; Frankel et al., 2012; Kochanska & Aksa, 2006).

Taken together, this evidence suggests that children’s obesity risk is increased through the effect that parent-child relationship quality (i.e., attachment) has on children’s self-regulatory processes that influence eating behaviour (e.g., coping skills; appetite; sleep; Anderson & Keim, 2016) *and* via dysfunctional parent-child feeding interactions, such as those involving excessive controlling feeding practices, that can disrupt children’s innate ability to respond to internal hunger and fullness cues (Mitchell, Farrow, Haycraft, & Meyer, 2013). Hence, our model proposes that associations between maternal body satisfaction and early parenting quality may influence early dyadic mother-child pathways to child self-regulation, which in turn influences child eating behaviour and obesity risk.

Opportunities for intervention

Our conceptual model, based on empirical evidence, shows the relationship between maternal body dissatisfaction and both maternal and childhood obesity risk

during pregnancy, postpartum and early parenting. It specifically highlights the potential role of maternal body dissatisfaction during these critical prevention stages in influencing early dyadic mother-child pathways to childhood obesity.

Pregnancy and the postpartum period present key windows for intervention as women and infants typically attend frequent routine visits with health professionals during these periods. These visits present opportunities to assess maternal wellbeing, body image issues and weight concerns. These visits might provide an opportunity to support women to: 1) adapt to physical changes during pregnancy and postpartum; 2) meet IOM GWG guidelines and manage subsequent postpartum weight changes; and 3) identify if any emerging mental health concerns implicate body image issues. Postpartum visits with health professionals may also be an opportune time to identify concerns with attachment security, and child self-regulation or eating behaviour and offer supportive intervention. We acknowledge that there are a range of system barriers that may prevent health professionals from adopting these recommendations, including time constraints, lack of useful screening tools for image during pregnancy and training needs. Future research identifying enablers for implementing strategies that tackle body dissatisfaction, excess GWG and PPWR are therefore needed.

Conclusion and future directions

Maternal body image concerns, specifically body dissatisfaction, throughout pregnancy and in the postpartum period may be associated with maternal excess body weight and psychopathology. In turn, maternal adverse outcomes associated with body dissatisfaction (i.e., psychopathology, excess body weight, disordered eating) increase childhood obesity risk via its effects on biological (i.e., epigenetic programming in pregnancy) and relational/behavioural (i.e., mother-fetal bond in pregnancy; child

attachment relationship post birth) parent-child interactions underpinning the development of children's self-regulation and eating behaviours associated with weight status.

While our conceptual model is supported by theoretical and empirical findings, we emphasise the scarcity of research focused specifically on the relationships between body image and maternal and childhood obesity risk during pregnancy, postpartum and early parenting. Despite the link between maternal and childhood obesity, there is not yet an established, multidisciplinary, continuous life-course approach to obesity prevention. Our model provides a framework to bridge the gap between maternal and childhood obesity research fields and build the evidence base needed to progress prevention strategies aiming to combat early pathways to obesity from a life-course perspective. Additionally, we have focused here on the relationship between maternal and child weight from as early as pregnancy because pregnancy is a time when women experience rapid physical changes that may impact their attitudes and perspective relating to body image. However, we acknowledge that preconception is just as important for modifying weight-related health behaviours, and must not be ignored in prevention efforts aimed at reducing maternal and childhood obesity (Skouteris et al., 2019). We must also acknowledge that our model is dyadic in nature and focuses on maternal/child eating behaviour to highlight early pathways linking parent-child feeding interactions to child obesity risk; this focus is not intended to detract from considering the important role that other factors, such as physical activity (Appelhans et al., 2012), ethnicity (Cardel et al., 2012) and socioeconomic status (Jones, 2018), play in determining weight status. Furthermore, significant headway in reducing childhood obesity will not be made unless a systems approach is taken concurrently, to ensure that the environment within which mother-child dyads live is conducive to the

development of positive psychosocial wellbeing and lifestyle behaviours (Nader et al., 2012). High quality longitudinal research focused on identifying modifiable pathways between perinatal maternal and childhood excess body weight during early life stages is needed to inform family-focused prevention strategies aimed at reducing the burden of maternal and childhood obesity.

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