Maternal depression, anxiety, body dissatisfaction and self-esteem: do they increase the risk of pre-schooler obesity?

by

Pree Benton
Bachelor of Psychology (Honours) (Monash University)

Submitted in partial fulfilment of the requirements for the degree of

Doctor of Psychology (Health)

Deakin University
DEAKIN UNIVERSITY

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Abstract
This thesis aimed to examine the relationship between maternal psychosocial variables, including depressive and anxiety symptoms, self-esteem and body dissatisfaction, maternal restrictive and pressure feeding practices, and pre-schooler obesity risk in an Australian sample. The first study was a systematic literature review of the relationship between maternal psychopathology and pre-schooler obesity risks. The review revealed associations between maternal depressive symptoms and increased risks for pre-schooler obesity, however there was a paucity of research examining whether maternal anxiety, self-esteem or body dissatisfaction were associated with pre-schooler obesity risk. Therefore, two empirical studies were undertaken to address this gap in the literature. The first study was a cross-sectional examination of the relationships between maternal psychosocial measures; pressure and restriction feeding practices, and pre-schooler BMI-z scores at age two. A hierarchical regression found that none of the maternal psychopathology measures or feeding practices predicted child BMI-z scores, although maternal BMI and employment status did predict pre-schooler BMI-z. Independent t-tests revealed that significantly more mothers with elevated body dissatisfaction scores had children with higher BMI-z scores. A second study examined these same relationships longitudinally within a path model, following the children up 2 years later (mean 26 months). Only baseline family income predicted increased pre-schooler BMI-z scores at follow-up. Independent t-tests revealed no differences in pre-schooler BMI-z change between mothers with and without elevated scores on the psychosocial measures. These findings suggest that maternal psychosocial health may not increase the risk of obesity in pre-schoolers, however the sample was demographically homogenous, skewed towards higher education and socioeconomic status. There were low percentages of mothers with elevated scores on the psychosocial measures, and low numbers of pre-schoolers within overweight and obese weight categories. Further research needs to replicate these findings in similar and
diverse populations with a higher prevalence of maternal psychopathology and child overweight/obesity to further explore the interplay between these variables.
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Chapter One
Introductory Literature Review

Childhood overweight and obesity is becoming an ever increasing problem, with current estimates that approximately 42 million children under the age of five are overweight, 35 million whom are living in developed countries (World Health Organisation, 2012). Research has shown notable increases in obesity rates in preschool-aged children in both developing and developed countries over the past three decades, and it is estimated that 70 million children worldwide will be obese by 2025 (World Health Organisation, 2014). The most recent national Australian statistics indicate that almost one quarter of children aged 2 to 18 are overweight or obese, with 18.2% of children being overweight, and a further 6.9% obese (Australian Bureau of Statistics, 2013a). Rates of child overweight in Australia are projected to increase to 37% by 2025 (Department of Human Services, 2008). Obesity is defined as having a body mass index (BMI) of 30 or above and calculated via the following formula: weight (in kilograms) divided by height (in metres) squared (kg/m²). However, for children the World Health Organisation (WHO) has developed international standards for age and sex specific BMI cut-offs (WHO Multicentre Growth Reference Study Group, 2009b).

Although there is little research examining the prevalence of overweight and obesity in preschool-aged children specifically, a study by Vaska and Volkmer (2004) examined weight status in Australian 4-year olds, and found that in 2002, rates of overweight and obesity were 13.1% and 4.1%, respectively, compared to 6.9% and 3.2% in 1995. The increases in obesity rates were denoted as 7.1% and 8.6% in boys and girls, respectively, both of which were statistically significant. More recently published data (Zhou, Gibson, Gibson, & Makrides, 2012), derived from a nationally representative cross-sectional study of pre-
schoolers, found 17% of 1-5 year old Australians were overweight, and 14% were obese. This highlights the increasing rates of overweight and obesity in preschool aged children, when compared to Vaska and Volkmer (2004) data from only a few years prior.

Childhood obesity is linked to a wide range of physical comorbidities, including Type II Diabetes (Inge, Xanthakos, & Zeller, 2007; Kim et al., 2008; Steinbeck, 2010), hypertension (Pott, Albayrak, Hebebrand, & Pauli-Pott, 2010a; Strauss, Bradley, & Brolin, 2001), cardiovascular diseases (Ali, Fang, & Rizzo, 2010; Gunnell, Frankel, Nanchahal, Peters, & Davey Smith, 1998; Kim et al., 2008), non-alcoholic fatty liver disease (Inge et al., 2007; Ludwig, 2007; Zeller, Modi, Noll, Long, & Inge, 2009), obstructive sleep apnoea (Strauss et al., 2001; Treadwell et al., 2007) and Polycystic Ovarian Syndrome (Steinbeck, 2010). Childhood obesity also produces musculoskeletal and orthopaedic problems (Kim et al., 2008; Treadwell et al., 2007). These serious physical health problems, which were previously not seen at such young ages (Daniels, 2006), have also been shown to continue and worsen into adulthood (Eddy et al., 2007a). Furthermore, evidence suggests that there is a high risk of children who are overweight/obese maintaining overweight and obese status into adulthood (Ferraro, Thorpe, & Wilkinson, 2003; Mustillo et al., 2003; Power, Lake, & Cole, 1997; Serdula et al., 1993).

Apart from these severe physical ailments, childhood overweight and obesity has also been associated with the development of a wide array of serious psychological comorbidities and poorer psychosocial functioning in adulthood (Gortmaker, Must, Perrin, Sobol, & Dietz, 1993; Inge et al., 2007; Must, Jacques, Dallal, Bajema, & Dietz, 1992; Power et al., 1997). The incidence of clinically diagnosed mood and anxiety disorders during adulthood has been found to be significantly higher in those who were overweight or obese during childhood compared to those who were healthy weight (Boutelle, Hannan, Fulkerson, Crow, & Stice, 2010; Sanderson, Patton, McKeercher, Dwyer, & Venn, 2011). Overweight and obesity during
childhood has also been associated with significantly higher body dissatisfaction and poorer self-concept in adulthood (Power et al., 1997), and greater psychiatric morbidity, including depression, anxiety, obsessive-compulsiveness, hostility, paranoid ideation and psychoticism in adulthood (Mills & Andrianopoulos, 1993). Child overweight and obesity has also been linked to lower rates of education, marriage, lower family income, and overall reduced health related quality of life in adulthood (Inge et al., 2007). Such evidence highlights the necessity of early intervention and prevention of childhood obesity, to reduce the mental health consequences later in life.

Child obesity also has a significant negative impact on psychosocial functioning during the childhood period itself. Reduced quality of life in both physical and psychological domains in comparison to healthy weight children has been frequently reported in studies of overweight and obese children (Riazi, Shakoor, Dundas, Eiser, & McKenzie, 2010; Tsiros et al., 2009; Williams, Wake, Hesketh, Maher, & Waters, 2005). Obese children are also likely to have greater difficulties making friends (Daniels, 2006), and are frequently the targets of weight-related teasing and stigmatisation (Eddy et al., 2007a; Hayden-Wade, Stein, Ghaderi, Zabinski, & Wilfley, 2005; Neumark-Sztainer et al., 2006; Steinbeck, 2010), which has been linked to depressive symptoms, (Chaiton et al., 2009), low self-esteem, and poor body image (Ali et al., 2010; Steinbeck, 2010). An Australian study of 2813 children from 55 schools across New South Wales found obese children had significantly lower body satisfaction, perceived social acceptance, athletic competence and global self-esteem, compared with their normal weight peers (Franklin, Denyer, Steinbeck, Caterson, & Hill, 2006). This suggests obese children are not only at risk of poor psychological health from low self-esteem and poor body image, but also at risk of perpetuating their weight status through low physical activity levels and avoidance of social engagement.
In addition to the aforementioned physical and psychological and psychosocial co-morbidities, overweight and obesity in the early childhood, or preschool years (i.e., ages 0-6), have been identified as particularly critical in the formation of enduring obesity problems (Eddy et al., 2007a; Fisher & Birch, 1999b; Pott et al., 2010a). The adiposity rebound period appears to play a key role in the development of child obesity (Dietz, 1997b; Rolland-Cachera, Deheeger, Maillot, & Bellisle, 2006; Williams & Goulding, 2008b). This is where, after steadily increasing during infancy, child BMI declines to its lowest point between ages 3 and 6, and then rebounds to increase again up until adulthood. Specifically, earlier adiposity rebound has been shown to predict a higher risk of obesity in adolescence and adulthood (Cole, 2004a; Williams & Goulding, 2008b). Dietz (1997) suggests that if the child fails to learn to self-regulate hunger and food intake during this period, for example, due to maternal feeding practices such as pressure and restriction, the child will be more susceptible to developing obesity. Given the significant role the formative years play in the development of persistent overweight and obesity into late childhood (Birch & Fisher, 1998b), adolescence, and even into adulthood (Clark, Goyder, Bissell, Blank, & Peters, 2007), it is important to identify factors that may influence child weight during the preschool years, in order to prevent later obesity.

A growing body of evidence has suggested that parenting may play a pivotal role in the onset of childhood obesity (Skouteris et al., 2011a; Ventura & Birch, 2008). As the mother is usually the primary caregiver (McPhie, Skouteris, Daniels, & Jansen, 2014), several maternal factors have been shown to be associated with risk factors for child overweight and obesity. These maternal factors include mothers’ own weight status (Whitaker, Jarvis, Beeken, Boniface, & Wardle, 2010), socio-demographic variables such as education and family income (Cho, Kang, Kim, & Song, 2009; Lamerz et al., 2005; Wang, 2001), feeding practices (Baughcum et al., 2001; Birch & Fisher, 2000; Birch, Fisher, &
Davison, 2003b; Fisher & Birch, 1999b; McPhie et al., 2014), and more recently, mothers’ psychological well-being (Fröhlich, Pott, Albayrak, Hebebrand, & Pauli-Pott, 2011; McConley et al., 2011; Topham et al., 2010b).

The remainder of this chapter will present a conceptual model of child obesity, with a specific focus on risk factors from the mother. The chapter firstly examines the broader maternal influences over child obesity, the impact of maternal feeding practices, and finally the relationship between maternal psychopathology and child obesity risk. Gaps and limitations within the current literature are also identified and discussed. In an attempt to address these, the present thesis aimed to explore the relationship between indices of maternal psychopathology, feeding practices, and risk for pre-schooler obesity. The indices of maternal psychopathology that are examined include depressive and anxiety symptomology, self-esteem and body dissatisfaction. Maternal child feeding practices include restriction of child food intake and pressuring child to eat. Pre-schooler obesity risk is measured by BMI-z score. The thesis aimed to address the following research question: does maternal psychopathology, including depressive and anxiety symptoms, body dissatisfaction and self-esteem, influence or increase pre-schooler obesity risk, via maternal feeding practices?

In order to present a thorough and rigorous review of the literature on the associations between the maternal psychopathology indices mentioned above, and risk factors for pre-schooler obesity, including: weight outcomes, dietary/nutrition habits, physical activity levels and sedentary behaviour, a systematic review of this question was conducted and has been accepted in Appetite (December, 2014). This paper is presented in chapter 2. Chapter 3 provides an overview of the two empirical studies conducted, and a detailed methodology section, where a statistical model to examine the research question is proposed.

The first empirical study examined the cross-sectional relationships between maternal psychopathology, feeding practices and pre-schooler BMI-z scores at child age 2. It was
hypothesised that higher scores on maternal psychopathology measures would predict higher child BMI-z, and that this relationship would be mediated by the use of restriction and pressure feeding practices. These relationships were tested using a hierarchical regression model. This study has been accepted for publication in Early Child Development and Care (*in press*, June 2015), and is presented in Chapter 4. The second empirical paper expands on the first by examining the same model longitudinally. Specifically, the aim of the second empirical study was to examine whether maternal psychopathology predicted maternal feeding practices, and whether these in turn predicted pre-schooler BMI-z score change from baseline to 24-month follow-up. It was hypothesised that maternal depressive and anxiety symptoms, self-esteem and body dissatisfaction would predict the use of maternal restriction and pressure feeding practices, and that these feeding practices would positively predict child BMI-z change at 24-month follow-up. These relationships were tested within a path model, and this study is presented in chapter 5. The sixth and final chapter presents a general discussion of the findings of the thesis as a whole. The theoretical and practical implications of the findings here are discussed in this final chapter.
Developmental Ecological Systems Theory of Child Overweight and Obesity

The aetiology of child obesity is widely debated, and is likely to be multifaceted. The simple explanation of obesity is that there is a greater energy intake than expenditure (Lobstein, Baur, & Uauy, 2005; Summerbell et al., 2005). Although this is undoubtedly a major contributing factor in the development of obesity, there are multiple variables that appear to underlie and influence this energy imbalance. Genetic and biological factors have been proposed as causes of obesity (Bell, Walley, & Froguel, 2005; Stunkard et al., 1986), but more often now attention is being paid to early environmental contributors, such as family and social factors (Anderson & Butcher, 2006; Lindsay, Sussner, Kim, & Gortmaker, 2006; Story, Kaphingst, & French, 2006). Individual factors, such as child gender (Wisniewski & Chernausek, 2009), and physical activity levels (Dowda, Pate, Pfeiffer, Sirard, & Trost, 2003; Tremblay & Willms, 2003b), are also now seen as important considerations in the understanding of obesity development.

A developmental, ecological model has been proposed by Harrison et al. (2011) which encapsulates the multi-faceted aetiology of childhood obesity, and acknowledges the complex interactions between individual factors, including genetic, psychological and environmental contributions. The foundation of this model are the “Six C’s” (see Figure 1.1), which comprises six layers: 1) Cell, which lies at the core of the model and relates to genetics and biological processes contributing to obesity; 2) Child, which relates to the child’s personal characteristics, e.g. self-regulation of hunger/eating; 3) Clan, i.e. familial factors such as parental dynamics and characteristics; 4) Community, e.g. the child’s social world, such as school, kindergarten, and child care, access to recreational facilities and food sources; 5) Country, e.g. state and national policies relating to nutrition, physical activity, etc.;
and 6) Culture, e.g. societal and cultural beliefs and values pertaining to health, eating, physical activity, etc. The core layers are thought to be proximal contributors, i.e. more directly influential on child weight status, while the outer layers are the distal factors, exerting their influence on child weight via the proximal factors. For example, societal values surrounding weight and body shape (Culture layer) may impact on mothers’ self-esteem and body image (Clan layer), which in turn impacts their child feeding practices (Clan layer), and subsequently, child weight status (Child layer).

Figure 1.1 The Six C’s developmental ecological model of the aetiology of childhood obesity.

Harrison et al.’s (2011) Six C’s model can be adapted for all stages of child development, from infancy through to adolescence. It is thought that at younger ages,
the child has less control over the impact of distal factors, however as they grow older, the child gains more control over them, e.g. self-determination of what and when to eat. Therefore, preschool-aged children may be particularly influenced by the proximal contributors, as they are still developing and have little control over the distal, superseding layers. As mentioned earlier, research suggests that the preschool age, rather than later childhood, is a period in which enduring eating patterns are formed (Birch & Fisher, 1998b), therefore addressing factors which may increase the risk for obesity from this age is essential.

Much of the research into child obesity risks currently focuses on family or parental factors, which fall under the second layer of the Six C’s model, Clan, a proximal contributor. Some examples of contributors within this layer include family SES and ethnicity, parental BMI, and parental physical and mental health (Harrison, et al., 2011). As mentioned above, recent literature suggests that maternal psychological health may play a large role in impacting the risk of child overweight and obesity (Fröhlich et al., 2011; McConley et al., 2011; Topham et al., 2010b). The remainder of this review will examine the available literature pertaining to Clan level contributors to child overweight and obesity, with a particular focus on mothers, and their psychosocial health.

Maternal Influences on Child Overweight and Obesity

Maternal overweight and obesity. There is considerable evidence supporting the link between overweight/obesity in mothers and children (Cutting, Fisher, Grimm-Thomas, & Birch, 1999; Davey Smith, Steer, Leary, & Ness, 2007; Francis, Hofer, & Birch, 2001; Oken, 2009). A large cross-sectional survey conducted in 4423 UK families, with children aged 2-15 years, examined the increased risk of child obesity with regard to parental weight status (Whitaker et al., 2010). Analyses revealed that
having two overweight parents increased child obesity risk twofold, compared with two healthy weight parents (BMI <25). Even more alarmingly, children with two obese parents (BMI 30-35) were at 12 times the risk for obesity, and those with two obese parents (BMI ≥ 35) were 22 times more likely to be obese, compared to children with two healthy weight parents. Only 2.3% of children with two healthy weight parents were obese, versus 35.3% of children of with two obese parents (BMI ≥ 35). These findings were independent of family socioeconomic status (SES), child age, and sex. These results are important because rates of severe obesity (BMI ≥ 40) have accelerated faster than general obesity (BMI ≥ 30) over the past four decades, and are expected to more than double over the next 20 years (Finkelstein et al., 2012). Thus, if parental rates of severe obesity continue to rise, so too will the prevalence of child obesity.

Another noteworthy finding of Whitaker et al.’s (2010) study was that maternal obesity was a significantly better predictor of child obesity than paternal obesity. This is consistent with research by Johannsen, Johannsen and Specker (2006) in a sample of pre-schoolers and their parents, which found maternal BMI was strongly related to child BMI and fat percentage, whilst paternal BMI showed no association with child weight variables. This suggests that maternal weight status may be more influential on pre-schooler BMI. An Australian study of children aged 6-13 also found strong positive associations between maternal BMI and child BMI z-scores (Gibson et al., 2007b). However, studies using samples of Australian preschool-aged children specifically are needed to better examine the specific relationship between maternal and child overweight/obesity in this at-risk age group.

Despite the evidence that maternal overweight and obesity has strong links to child overweight/obesity, or at least relations between mother-child BMI, these
relationships alone cannot explain the entire picture, as children of obese mothers are not always obese themselves, and many obese children have normal weight mothers. Therefore, there must be other maternal contributors influencing the development of child obesity. One strong risk factor for child overweight/obesity that has been identified is maternal feeding practices.

**Maternal feeding practices.** There is a large body of evidence to suggest the strong relationship between maternal child feeding practices and child overweight and obesity. Although these associations have been comprehensively reviewed elsewhere (Clark et al., 2007; McPhie et al., 2014; Thompson, 2010; Ventura & Birch, 2008), the present review will briefly consider these factors and how they may relate to other maternal characteristics, such as maternal psychopathology, that could impact on child overweight/obesity.

Restrictive feeding, defined as limiting a child’s access to certain food(s) with regard to quantity and/or frequency (Francis et al., 2001), has the biggest body of empirical evidence supporting its links to child overweight and obesity (Clark et al., 2007; Corsini, Danthiir, Kettler, & Wilson, 2008b; Kröller & Warschburger, 2008). Pressure feeding practices, characterised by pressuring children to eat all food put on their plate, especially healthy foods (Duke, Bryson, Hammer, & Agras, 2004), have also begun to receive attention and have shown associations with increased child overweight and obesity (Lee, Mitchell, Smiciklas-Wright, & Birch, 2001; Spruijt-Metz, Lindquist, Birch, Fisher, & Goran, 2002b). Research suggests that restrictive feeding promotes child overeating in uncontrolled settings (Fisher & Birch, 1995), particularly of energy-dense snacks (Fisher & Birch, 1999b). Higher restriction, pressure to eat, and general control over child’s eating behaviour is thought to hinder the child’s ability to self-regulate their eating by obstructing internal cues such as
hunger and satiety, and instead teaching children to rely on external cues, such as praise from parents for eating all the food on their plate (Francis et al., 2001). A cross-sectional study by Johnson and Birch (1994) found that higher parental control over child eating, including restriction and pressure, was related to lower self-regulation of caloric intake in pre-school children. Lower self-regulation was in turn related to higher adiposity in the children. A longitudinal study by Faith et al. (2004a) reported higher maternal restriction at age 5 predicted higher BMI z-scores at age 7 in children at high-risk for obesity (i.e. offspring of mothers who were obese pre-pregnancy), even after controlling for child BMI z-scores at age 3. These associations were not present in children of mothers with healthy pre-pregnancy weight, suggesting that maternal obesity influences the relationships between feeding practices and child BMI.

Conversely, a longitudinal study of 7-9 year olds by Webber, Cooke, Hill and Wardle (2010a) found no association between maternal feeding practices and child weight, change in BMI standard deviation score (BMI-SDS), fat mass or waist circumference at three-year follow-up. Baseline child weight variables were also unrelated to change in feeding practices over the three years, suggesting no relationships existed from either direction between child weight and parental feeding in this sample.

Fisher, Birch and Davison (2003b) examined relationships between maternal restrictive feeding and their female children’s eating in the absence of hunger from ages 5 through to 9. Higher levels of restriction at age 5 predicted more eating in the absence of hunger at ages 7 and 9, especially in those who were already overweight at age 5. Eating in the absence of hunger at age 5 was not related to restriction in cross-sectional analyses, which suggests this maladaptive eating pattern may be a
cumulative result of restrictive practices over time. Over the study period, increases in overeating were greatest in overweight girls subject to high maternal restriction. Within the same sample, an earlier published study (Fisher & Birch, 2002) found female children who ate in the absence of hunger were almost 5 times more likely to be overweight than female children who did not eat in the absence of hunger. Taken together, these results suggest restrictive feeding practices may lead to children relying on external eating cues and subsequently over-eating and developing obesity.

Francis and Birch (2005b) later published a paper of the same sample which reported that the associations between higher restriction and increases in female children’s overeating were limited to children of overweight mothers only. Additionally, female child BMI increases over the 5-year study were positively associated with increased eating in the absence of hunger, and furthermore were significantly greater in children of overweight mothers compared to those of normal weight mothers. However, mean levels of restriction did not differ significantly between normal and overweight mothers, despite the differences in weight gain and female children’s overeating. These results indicate that other influential maternal factors, beyond weight status and feeding practices, may be important in facilitating the development of overweight/obesity in children.

Whilst these papers have focused solely on female children, other research has reported that male children are impacted by maternal feeding practices also. Brann and Skinner (2005) found that pressure was used significantly less in male children with BMIs above the 85th percentile (overweight) compared to those falling within a healthy BMI range. There were however, no differences in use of restriction between healthy and overweight male children. Blissett, Meyer and Haycraft (2006) reported similar findings, where maternal pressure was negatively correlated with male pre-
schoolers’ BMI, although restriction was positively correlated with male pre-
schooler’s BMI. This study also included female pre-schoolers, but found no
relationship between maternal feeding practices and BMI in the female participants.
However, there were no significant differences between male and female children in
the overall use of restriction and pressure. This null relationship was also reported by
Haycraft and Blissett (2008) in a similar sample of pre-schoolers and their parents
from the UK.

Conversely, another study by Farrow and Blissett (2008) found both
restriction and pressure to eat (measured at age 1) were linked to significantly lower
child weight (standardized) at age 2. These predictors made significant contributions
to child weight at age 2 even after controlling for weight at age 1, as well as
breastfeeding, birth weight and child sex. Notably, the authors did report that pressure
to eat was correlated with lower birth weight, and thus suggest that mother of children
who are naturally lighter may be more likely pressure their children to eat. The
authors also caution that as the children in their sample are quite young and thus yet
to independently access food, the link between restriction and lower child weight may
suggest restriction to be a useful strategy for preventing weight gain at young ages.
However, with reference to the research presented above it appears that restriction
may lead to more harmful eating behaviours in older children. Taken together, these
studies demonstrate that the relationship between maternal feeding practices and child
weight are complex, and may not entirely explain the relationship between maternal
factors and pre-schooler overweight and obesity.

**Maternal psychopathology, body satisfaction and child feeding practices.**
A growing body of evidence is now suggesting that maternal psychopathology, such
as disordered eating and depressive symptomology, influence the relationship
between feeding practices and risk for child overweight/obesity, in both school aged-children and pre-schooler samples (Duke et al., 2004; Tiggemann & Lowes, 2002; Ystrom et al., 2012; Hurley et al., 2008; Haycraft & Blissett, 2008; Blissett & Haycraft 2008; Hauff et al.; Huang et al.; Francis Hofer & Birch, 2001). Duke et al. (2004) conducted cross-sectional analyses between maternal disordered eating symptoms and restriction and pressure feeding practices in a sample of seven year olds. Maternal body dissatisfaction had a significant positive correlation with pressure feeding practices in both male and female children, while bulimia and drive for thinness scores were not related to pressure. Restriction was also unrelated to any of the disordered eating symptoms.

In a sample of 5-8 year old children attending private schools in Australia, Tiggemann and Lowes (2002a) found that maternal dietary restraint was positively related to control over child eating, also in female children only. Conversely, maternal body dissatisfaction, was unrelated to feeding control, despite correlating with maternal dietary restraint. This may suggest maternal body satisfaction mediates the relationship between maternal dietary restraint and controlling feeding practices in daughters. However, the use of a novel measure of controlling feeding, which was not validated against other psychometrically sound measures or through a pilot study, might explain the lack of associations between maternal body dissatisfaction and controlling feeding.

In pre-school aged children, relationships between maternal psychopathology and unhealthy child feeding practices have also been demonstrated. Ystrom, Barker and Vollrath (2012a) examined the influence of maternal negative affect on child feeding practices in a sample of 14,122 mothers of three year-old children. Parental Locus of Control (LoC) was also measured with regard to whether mothers believed
their child’s behaviour was influenced more by their parenting (internal LoC) or other external factors not related to their parenting (external LoC), e.g. child temperament. Maternal negative affect (a combined measure of depression, anxiety, anger and low self-esteem) was strongly correlated with both restriction and pressure feeding practices, however these relationships were entirely mediated by external LoC. These results suggest that maternal depression, anxiety and self-esteem may increase unhealthy feeding practices, depending on mothers’ perceived level of responsibility in the care of their child, and thus may subsequently increase the risk for child overweight/obesity.

Hurley, Black, Papas and Caulfield (2008a) also reported cross-sectional relationships between maternal psychopathology indices and unresponsive feeding strategies (i.e., authoritarian feeding styles where the child’s self-regulation ability is ignored). Maternal depression, anxiety and stress symptomatology were all positively related to the use of unresponsive feeding practices with infants (0-12 months). These associations remained significant even after adjusting for demographic covariates. All three psychopathology indices were positively associated with forceful and uninvolved feeding, while depressive symptoms were also related to indulgent feeding styles, and anxiety symptomology related to restrictive feeding. Severe maternal psychopathology (i.e. mothers scoring in the top quartile on two or more of the mental health indices) was associated with forceful, restrictive and uninvolved feeding. Unresponsive feeding styles were more commonly used by mothers who were younger, less educated, single, not currently breastfeeding, and had male children. Responsive feeding, which may protect against child overweight/obesity (Birch & Fisher, 1995; Hughes, Power, Fisher, Mueller, & Nicklas, 2005) was associated with higher maternal education, breastfeeding (current or ever) and female
infant gender. Consistent with Ystrom et al.’s (2012) study, maternal depressive and anxiety symptomology, as well as stress levels, appear to be influential in the use of unhealthy feeding practices. It is interesting to note that both these studies found male children were more likely to be exposed to restrictive (Ystrom et al., 2012) and unresponsive (Hurley et al., 2008) feeding styles, suggesting male offspring may be at higher risks for overweight/obesity via these unhealthy feeding practices, when maternal psychopathology is considered.

A study by Haycraft and Blissett (2008b) examined a range of maternal psychopathology variables, including depression, anxiety, body dissatisfaction and disordered eating, and their relation to child feeding practices in a sample of 2-5 year olds. In female children only, mothers’ higher scores on the depression, anxiety, psychoticism, and hostility subscales of the BSI, as well as the Global Severity Index (GSI) scores from this measure, were associated with higher pressure to eat. Scores on the Bulimia subscale of the EDI-2 showed the only significant correlation with restrictive feeding in female children; conversely, in sons, the higher maternal phobic anxiety (BSI subscale) was the only significant correlate of restrictive feeding, while general psychopathology (GSI) and interpersonal sensitivity subscale scores were positively correlated with pressure to eat.

Conversely, based on a subsample of the same participants, but analysing sons and daughters together, Blissett and Haycraft (2008) reported restriction was positively correlated with Bulimia subscale scores and lower maternal education attainment, but no other variables were related to feeding behaviours, including child BMI z-scores, maternal BMI and SES. Body dissatisfaction and drive for thinness subscale scores on the EDI-2 were also unrelated to child feeding practices in the sample as a whole. In another study, Blissett, Haycraft and Meyer (2006) reported
that maternal bulimia symptoms were significantly correlated with restrictive feeding in female children, but not male children.

Francis, Hofer and Birch (2001) reported that higher maternal weight and eating investment predicted restrictive feeding practices in 5-year old daughters. Maternal investment in weight and eating was measured using the Restraint scale of the Three Factor Eating Questionnaire (Stunkard & Messick, 1985) and an adaptation of the Weight Concern Scale (Killen et al., 1994); restrictive feeding using the CFQ (Francis et al., 2001). Furthermore, in this model, neither maternal depression, parenting style, education level, family income, nor mothers’ concern with or perceptions of daughters’ weight, or daughters’ actual weight status, was predictive of restrictive feeding. Such evidence highlights the importance of evaluating the contribution of maternal body satisfaction to the risks for child obesity, as this variable may play a more important role than socio-demographics and depressive symptomology. The finding that restriction was not related to mothers’ perceptions of or concerns with daughters’ weight, or daughters’ actual weight also suggests that unhealthy child feeding practices may operate independently of actual child factors and instead are influenced by mothers’ own internalisations relating to body ideals.

Evidence also suggests that even before the child is born, maternal body dissatisfaction can influence child feeding practices. Hauff and Demerath (2012a) examined relationships between maternal BMI, body satisfaction and breast-feeding duration in a prospective study that followed a sample of 257 first-time mothers from the third trimester of pregnancy, up to 4-6 months postpartum. Results demonstrated that overweight and obese mothers breastfed for significantly shorter durations than healthy weight mothers. Mediation analyses found this relationship was fully explained by discomfort with one’s body during the post-partum period, meaning that
due to body dissatisfaction, overweight and obese mothers tended to breastfeed their infants for shorter durations than healthy weight women, and for shorter durations than recommended (American Academy of Pediatrics, 2005). Given that shorter breast-feeding duration has been linked to excess weight and obesity in childhood (Harder, Bergmann, Kallischnigg, & Plagemann, 2005), this study suggests maternal body dissatisfaction may influence the risk for child obesity beginning as early infancy. However, this study measured body satisfaction using a single item, asking “are you comfortable with and self-confident in your body?”, thus these findings need to be replicated using psychometrically sound measures of body satisfaction.

Huang, Wang and Chen (2004) also noted a negative relationship between maternal body image and intentions to breastfeed in a sample of 195 pregnant Taiwanese women. It was found that mothers with lower pre-pregnancy body satisfaction, measured retrospectively by the Attitude to Body Image Scale (Strang & Sullivan, 1985), were less likely to intend to breastfeed. However, body dissatisfaction during the third trimester (measured contemporaneously) was no different between mothers intending to breastfeed and those intending to bottle-feed. Furthermore, the outcome variable of this study was intended, not actual feeding method, limiting the conclusions about that can be drawn from these findings. However, the study does suggest that maternal body satisfaction can influence risks for child overweight/obesity, via feeding practices, before the child is even born.

Based on these reviewed studies, there is a wealth of evidence that attests the connection between maternal psychological health, and unhealthy child feeding practices such as pressure and restriction. Given that these unhealthy feeding practices have been linked to poorer child self-regulation of hunger and eating (Birch, McPhee, Shoba, Steinberg, & Krehbiel, 1987; Carper, Fisher, & Birch, 2000; Fisher
& Birch, 2002; Johnson & Birch, 1994) and child overweight/obesity (Faith & Kerns, 2005; Johnson & Birch, 1994; Spruijt-Metz et al., 2002b; Ventura & Birch, 2008), maternal psychopathology such as depressive and anxiety symptomology, and maternal body dissatisfaction, may significantly increase the risk for child obesity via unhealthy feeding practices.

Furthermore, feeding practices may be employed differently between child genders, with some studies finding male and female children were differentially exposed to unhealthy feeding practices, depending on maternal psychopathology symptomology (Haycraft & Blissett, 2008; Blissett, Haycraft & Meyer, 2006), others finding male offspring of mothers who evidenced depressive and anxiety symptoms were at higher risk of more restrictive (Ystrom et al., 2012) and unresponsive (Hurley et al., 2008) feeding practices. However, research has also reported no sex differences in feeding practices (Duke et al., 2004), or failed to analyse these relationships separately for male and female children (Hauff & Demerath, 2012; Huang et al., 2004). Given these mixed results, future research needs to examine the impact of maternal psychopathology on feeding practices differentially between male and female to truly evaluate whether differential risks for overweight and obesity exist between the sexes.

It must be acknowledged that while many significant associations were reported between maternal psychopathology indices and unhealthy child feeding practices, findings were largely mixed across studies. None of the psychopathology indices were consistently related to any one type of unhealthy feeding practices, and feeding practices were not always associated with psychopathology. Therefore, further investigation of these relationships, and their potential impact on child overweight/obesity risk is warranted. Furthermore, none of the studies evaluated
whether feeding practices were related to child weight status, thus it is not possible to
determine whether the links between maternal psychological health and feeding
practices actually impact child overweight/obesity risks based on the current
literature. One avenue for further consideration is the relationship between maternal
psychopathology and child overweight/obesity.

**Maternal Psychopathology and Overweight and Obesity in School-Aged
Children**

Most of the extant literature that has examined the relationship between
maternal psychopathology on child weight status has focused on maternal depression
in school-aged children. There are several studies that have specifically examined
links between maternal depression and child underweight (Anoop, Saravanan, Joseph,
Cherian, & Jacob, 2004; Surkan, Ryan, Vieira, Berkman, & Peterson, 2007), which is
thought to result from neglectful or unresponsive parenting (Hurley et al., 2008a;
Stewart, 2007). However, this inverse relationship between maternal depression and
child weight status appears to be strongest in developing countries, with mixed
evidence for these associations in developed countries with higher socio-economic
samples (Husain, Cruickshank, Tomenson, Khan, & Rahman, 2012; Stewart, 2007;
Wright, Parkinson, & Drewett, 2006). In fact, there is some evidence to suggest, at
least in developed countries, that maternal depression *increases* the risk of obesity
(Gundersen, Lohman, Garasky, Stewart, & Eisenmann, 2008b; McConley et al., 2011;
Topham et al., 2010b).

McConley et al. (2011) explored the cross-sectional relationship between
maternal depressive symptoms and child BMI in a US sample of predominantly low-
SES Hispanic or African American 5th graders (mean age 11 years) and their mothers.
The researchers found mothers with elevated depressive symptoms were more likely
to have obese children, and children with higher BMI percentiles in general, compared to mothers without significant depressive symptomology. These results were independent of child gender. Mediation analyses revealed that maternal depression had a direct positive effect on child BMI percentile, and also an indirect effect, mediated by lower parenting quality, based on scales measuring family cohesion and maternal nurturance (Barnes & Windle, 1987; Olson, 1993). Lower parenting quality was in turn associated with less physical activity, poorer diet and more sedentary behaviour in children. Furthermore, less physical activity and more sedentary behaviour predicted higher child BMI percentile. These results suggest that interactions between maternal depression and parenting quality may increase risks for child overweight/obesity, via child diet and activity behaviours.

Topham et al. (2010) used a cross-sectional design to examine the relationship between maternal depressive symptoms, parenting styles and child obesity in a sample of rural first-grade (mean age: 6.85 years) children in the US. They found that maternal depressive symptoms moderated the relations between permissive parenting style and child obesity, where depression increased the risk of child obesity by 6.74 units in children of permissive mothers. This study was strengthened by comparing mothers with and without significant depressive symptoms (scores ≥ 16 classified as depressed; n = 36, non-depressed n = 140), rather than simply correlating child BMI with depressive symptomology scores. However, the number of mothers evidencing significant symptomology was small, suggesting analyses were based on a restricted range.

Permissive parenting, characterised by low demandingness and responsiveness, has been associated with poor involvement in children’s food choices (Blissett & Haycraft, 2008; Hubbs-Tait, Kennedy, Page, Topham, & Harrist, 2008),
and maternal depression has also been linked to less responsive and lax disciplinary parenting (Johnson, Cohen, Kasen, Smailes, & Brook, 2001). Therefore, the increased risk for child obesity may be explained by a lack of control or awareness over the child’s dietary intake, i.e., allowing intake junk foods, or excess food intake. This is consistent with McConley et al.’s (2011) study above that found lower parenting quality was linked to poorer diet, less physical activity and more sedentary behaviours in children.

Maternal stress may also increase the risk of child obesity. Gunderson et al. (2008b) examined the relationship between maternal stress, SES and child obesity in US children from very low SES families (200% below the poverty line). The researchers found children within this sample who were from food secure households (i.e., adequate finances to access food to maintain the health of all family members) were at greater risk of child obesity, only when maternal stress was present, while the interaction between maternal stress and food insecurity reduced the likelihood of child obesity. When segregating the results by age group, the increased obesity risk was only present in 3-10 year old children, but not 11-17 year olds.

These findings illustrate the importance of addressing risk factors of obesity during the early years, where child weight may be heavily influenced by poor maternal psychosocial health. This is consistent with Harrison et al.’s (2011) six C’s ecological model, whereby at young ages, children are strongly influenced by proximal layers, such as their parents, when they are less able to exert control over these external factors. It should be noted however, that Gunderson et al.’s (2008) measure of maternal stress was a cumulative index, which collectively considered maternal mental health (depression, anxiety, and panic symptoms), physical health, financial stressors and family structure. When these individual measures were
considered in isolation, none made a significant contribution to the prediction of child obesity. Thus, it is difficult to pinpoint the major contributors to child obesity risk, but these findings highlight the fact that various forms of parental stressors are influential. Additionally, the mean number of depressive and anxiety symptoms in this sample was less than one (out of a possible 9), indicating the prevalence of mothers with significant psychopathology was low.

Maternal depressive symptoms have also been associated with poorer success rates in weight loss interventions for overweight and obese children. Pott, Albayrak, Hebebrand and Pauli-Pott (2009) conducted a 12-month weight loss intervention in 7-15 year old overweight and obese children, and found at the end of the intervention, children of mothers who evidenced elevated psychopathology were significantly less likely to respond to the treatment, i.e., drop-out before completion, or achieve less than 5% BMI-SDS reduction. Maternal avoidant attachment was also related to poorer treatment response, and significantly associated with maternal depressive symptoms. These findings suggest that compromised interactions between mother and child, particularly investment in child diet and physical activity, may explain the cause and persistence of child obesity. Previous literature has noted that both maternal depression and avoidant attachment compromise healthy child development (Cummings & Davies, 1994; NICHD Early Child Care Research Network, 1999). Child age also played a role in treatment efficacy in Pott et al.’s (2009) study, with non-responding children being significantly older ($M = 11.7$, $SD = 1.8$) than responders ($M = 10.6$; $SD = 1.9$). This again highlights the importance of tackling child overweight and obesity at very early ages to ensure the problem does not persist into older ages, where it may be less amenable to change (Huston, Wright, Marquis, & Green, 1999).
A one-year follow-up of this program (i.e., 12 months from treatment end) found maternal depressive symptomology (i.e., scoring above the cut-off) was the strongest predictor of children achieving <5% BMI-SDS reduction at follow-up (Fröhlich et al., 2011). Logistic regression also revealed that maternal obesity increased the risk of non-response to treatment by almost four times, suggesting this variable has quite a strong influence over child weight status; this is consistent with other research noted earlier in the current review (Cutting et al., 1999; Gibson et al., 2007b; Whitaker et al., 2010).

Despite the numerous studies that have identified strong links between maternal psychopathology and child overweight and obesity (Gundersen et al., 2008b; McConley et al., 2011; Pott et al., 2009; Topham et al., 2010a) other studies have failed to find relationships between these variables (Ajslev, Andersen, Ingstrup, Nohr, & Sørensen, 2010; Gibson et al., 2007b). Gibson et al. (2007) conducted a cross-sectional study of the relationships between maternal psychopathology and child BMI-z scores in three samples of children: healthy weight, overweight/obese treatment seeking, and overweight/obese non-treatment-seeking, all aged between 6 and 13, Gibson et al. (2007b) found maternal depressive and anxiety symptoms, stress and self-esteem were not associated with child BMI z-scores in a regression model. Conversely, higher maternal BMI and low SES (including low maternal education, family income and social disadvantage) were positively related to child BMI-z score.

Null associations between maternal psychopathology and child overweight/obesity risk have also been noted longitudinally (Ajslev et al., (2010). The researchers reported that maternal distress (measured six months postpartum) did not predict child overweight at age seven. Notably, distress was measured using a combination of items from psychometrically validated questionnaires tapping into...
depression, anxiety and stress. This adapted measurement tool was not, however, validated in the study sample, potentially reducing the validity of their findings. Interestingly, maternal distress was correlated with shorter breastfeeding duration, which has been related to higher child overweight/obesity risk (Harder et al., 2005), as noted earlier in this review (Hauff & Demerath, 2012a). This highlights the complexity of the interactions between maternal psychopathology and the risks for child overweight and obesity, and that these relations may not always show direct links with child BMI.

Apart from the many studies examining the impact of maternal depression, and to some extent anxiety and self-esteem, there appears to be no current literature examining the relationships between maternal body satisfaction on school-aged children’s risk for overweight and obesity. Furthermore, given several studies have noted that younger children’s weight status is more vulnerable to maternal psychopathology influences (Gundersen et al., 2008b; Pott et al., 2009), it is crucial to examine younger, pre-school aged children in isolation, to pinpoint risk factors for overweight and obesity that may emanate from the mother.

Summary

Although much attention has been paid to maternal influences on risks for child obesity in the literature to date, research has generally focused on maternal feeding practices. However, a growing body of evidence is now suggesting that maternal psychopathology, such as depression, may also be impact on these risks, either by impacting on maternal feeding practices, or directly on child weight status. Moreover, research has generally focused on broader child age groups, that is, i.e. later childhood or adolescence. The next chapter presents a systematic review of the
existing literature that examines the relationship between maternal psychopathology and pre-schooler obesity risks.
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Chapter Two

Systematic review paper: Does maternal psychopathology increase the risk of pre-schooler obesity? A systematic review

Pree Benton¹, Helen Skouteris¹, Melissa Hayden¹

School of Psychology, Deakin University, Melbourne, Australia

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Correspondence: Pree Benton, School of Psychology, Deakin University, 221 Burwood Highway, Burwood, Victoria, Australia, 3125. Email: pbento@deakin.edu.au

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Abstract

The preschool years may be a critical period for child obesity onset, however literature examining obesity risk factors to date has largely focused on school-aged children. Several links have been made between maternal depression and childhood obesity risks, however other types of maternal psychopathology have been widely neglected. The aim of the present review was to systematically identify articles that examined relationships between maternal psychopathology variables, including depressive and anxiety symptoms, self-esteem and body dissatisfaction, and risks for pre-schooler obesity, including weight outcomes, physical activity and sedentary behaviour levels, and nutrition/diet variables. Twenty articles meeting review criteria were identified. Results showed positive associations between maternal depressive symptoms and increased risks for pre-schooler obesity in the majority of studies. Results were inconsistent depending on the time at which depression was measured (i.e., antenatal, postnatal, in isolation or longitudinally). Anxiety and body dissatisfaction were only measured in single studies, however both were linked to pre-schooler obesity risks; self-esteem was not measured by any studies. We concluded that maternal depressive symptoms are important to consider when assessing risks for obesity in preschool-aged children, however more research is needed examining the impact of other facets of maternal psychopathology on obesity risk in pre-schoolers.

Keywords: pre-schooler; early childhood; obesity; obesity risk factors; mother; maternal psychopathology; maternal depression
Introduction

Childhood overweight and obesity is an ever increasing problem, with current estimates that approximately 42 million children worldwide under the age of five are overweight, 35 million of which are living in developed countries (World Health Organisation, 2012). Most recent national statistics in the US indicate 17% of children aged 2-19 years, and 10.4% of children aged 2-5 years are obese (Ogden, Carroll, Kit, & Flegal, 2012). Comprehensive reviews have identified notable increases in obesity rates in preschool-aged children, in both developing and developed countries over the past three decades (De Onis & Blossner, 2000; Martorell, Kettel Khan, Hughes, & Grummer-Strawn, 2000; Wang & Lobstein, 2006).

A growing body of evidence has suggested that parents play a pivotal role in the development of childhood overweight and obesity (Skouteris et al., 2011a; Ventura & Birch, 2008). Several maternal factors have been identified as risk factors for child overweight and obesity, including maternal overweight/obesity (Whitaker et al., 2010), socio-demographic variables such as education and family income (Cho et al., 2009; Lamerz et al., 2005; Wang, 2001), pressure and restrictive feeding practices (Baughcum et al., 2001), and more recently, maternal psychological well-being (McConley et al., 2011; Topham et al., 2010b), including depression, self-esteem and anxiety (Gundersen, Lohman, Garasky, Stewart, & Eisenmann, 2008a; McConley et al., 2011; Pott, Albayrak, Hebebrand, & Pauli-Pott, 2010b; Topham et al., 2010b). Studies have also demonstrated associations between maternal body dissatisfaction and child obesity risk factors, such as, shorter breast-feeding duration (Hauff & Demerath, 2012b) or bottle-feeding only (Huang et al., 2004), and restrictive and pressure feeding practices (Duke et al., 2004; Francis et al., 2001; Lowes &
There is also evidence that maternal body dissatisfaction, modelling of weight concerns, and restrictive eating are associated with body dissatisfaction and restrictive eating in offspring (Anschutz, Kanters, Strien, Vermulst, & Engels, 2009; Gonçalves, Silva, Gomes, & Machado, 2012; Keery, Eisenberg, Boutelle, Neumark-Sztainer, & Story, 2006; McCabe et al., 2007). Body dissatisfaction is an increased risk for later overweight and obesity (Neumark-Sztainer et al., 2006; Shunk & Birch, 2004; Stice, Presnell, Shaw, & Rohde, 2005).

Maternal psychopathology may also be related to lifestyle risk factors for child overweight/obesity, including low physical activity levels, poor nutrition, and increased sedentary behaviour (Sothern, 2004; Taveras, Gillman, Kleinman, Rich-Edwards, & Rifas-Shiman, 2010; Tremblay & Willms, 2003a; Trost, Sirard, Dowda, Pfeiffer, & Pate, 2003; Viner & Cole, 2005). McConley and colleagues (2011) found a significant association between maternal depressive symptoms and child BMI, which was mediated by lower child physical activity and higher sedentary behaviour. Thus, it is important to consider the various ways in which maternal psychosocial health may impact on children’s risk for overweight and obesity.

While most of the child obesity literature has focused on school-aged children, the preschool years (i.e., ages 2-6) have been identified as critical in the formation of enduring obesity problems (Eddy et al., 2007b; Fisher & Birch, 1999a; Pott et al., 2010b; Reilly et al., 2005b). It is thought that if the child fails to learn to self-regulate hunger and food intake during this period, he/she will be more susceptible to developing obesity (Dietz, 1997a). The pre-school period also precedes the onset of major social and community influences on child weight status. Once children commence school, they are exposed to broader factors that may contribute to obesity risk, such as peer attitudes towards food and physical activity (Cullen, Baranowski,
Rittenberry, & Olvera, 2000; Finnerty, Reeves, Dabinett, Jeanes, & Vögele, 2010; Grimm, Harnack, & Story, 2004). Thus, the pre-school years are a critical period for identifying obesity risk factors closer to the child, such as maternal influences, without the additional confounding impact of the child’s wider community. Given the significant role the formative years play in the development of persistent overweight and obesity in later childhood (Birch & Fisher, 1998b), adolescence, and even into adulthood (Clark et al., 2007), it is important to identify factors that may influence child weight during the preschool years in order to prevent later obesity and its myriad of complications.

The main aim of this paper therefore, was to systematically review the existing literature that examines relationships between maternal psychopathology, including depression, anxiety, self-esteem and body dissatisfaction, with risk factors for overweight and obesity in preschool-aged children. In light of the above literature examining obesity-promoting risk factors, the present review defines pre-schooler obesity risk factors as either child weight-related variables (e.g., BMI z-scores), or lifestyle risk factors including physical activity levels, nutrition and dietary variables (e.g. soft-drink consumption), or sedentary behaviours (e.g. TV viewing time). Thus, studies including any of these indices of pre-schooler obesity risk as outcome variables were included. We are aware of two other systematic reviews that have considered the relationship between maternal depressive symptoms and childhood obesity (Lampard, Frankle, & Davison, 2014; Milgrom, Skouteris, Worotniuk, Henwood, & Bruce, 2012). However, these reviews focused exclusively on the impact of maternal depressive symptoms exclusively, whereas our review extends beyond maternal depression to also include studies examining maternal anxiety, self-esteem and body dissatisfaction, providing an expansive insight into the potential maternal
mental health risk factors for child obesity. Our review also expands on these previous reviews by including broader indicators of child obesity, such as physical activity, sedentary behaviours and nutrition/diet variables, whereas the reviews by Milgrom et al. (2012) and Lampard et al. (2014) examined only child weight outcomes. Finally, as identified above, the pre-school years appear to be a critical period in the development of obesity, therefore our review focused exclusively on pre-school aged children (up to 6 years) only, compared to school-aged children up to age 8 (Milgrom et al., 2012), and children and adolescents aged up to 18 (Lampard et al., 2014). Two papers in the Milgrom et al. (2012) review, and five papers in the Lampard et al. (2014) review were identified in our systematic search and have been included in the current review. Thus, our review is the first to examine the influence of a wider range of maternal psychopathology variables on the weight, activity and diet-related risks for obesity, exclusively in preschool aged children. A secondary aim of the review was to outline the strengths and limitations of the existing literature examining maternal psychopathology and pre-schooler obesity risks, articulating any gaps to be addressed by future research, in order to improve the study of maternal factors linked to obesity risk in pre-school children.

Method

Search Strategy

Articles were sourced from three databases: Medline, PsychINFO, and Global Health. The review adhered to the PRISMA guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009), a 27-item checklist that informs the necessary components of a systematic review aiming to identify, select and critically evaluate relevant research to the review question. It also provides a four-phase diagram of the processes involved in systematically identifying and selecting articles for review inclusion. In addition to
database searching, a hand search of the reference lists of articles meeting inclusion criteria yielded in the systematic search was conducted. The search terms used to identify relevant articles in the current review are provided in Box 2.1.

<table>
<thead>
<tr>
<th>Box 2.1. Search terms</th>
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<tbody>
<tr>
<td>maternal OR mother* OR mum OR mom</td>
</tr>
<tr>
<td>psychopatholog* OR psychological morbidit* OR depress* OR depressive disorder OR anxiety OR anxiety disorder</td>
</tr>
<tr>
<td>body satisfaction OR body dissatisfaction OR body image OR concern AND body OR weight OR shape OR preoccupation AND weight OR shape OR self-concept OR &quot;self concept&quot; OR self-esteem OR &quot;self esteem&quot;</td>
</tr>
<tr>
<td>child* OR pediatric* OR preschool* OR pre-school* OR &quot;pre school&quot; OR kinder*</td>
</tr>
<tr>
<td>weight OR BMI OR body mass index OR body size OR &quot;weight status&quot; OR &quot;body shape&quot; OR shape OR obes* OR overweight</td>
</tr>
<tr>
<td>diet* OR nutrition) OR eating OR eating behavi<em>r OR eating habit</em> OR food consump* OR food intake</td>
</tr>
<tr>
<td>physical activity OR exercis* OR sedentary behavio*r OR inactivity</td>
</tr>
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**Inclusion and exclusion criteria.** Eligible studies were published between January 2000 and January 2014, in English language. As the influence of maternal factors on preschool obesity is a contemporary research issue, we chose to limit studies to post-2000 to ensure results were not out-dated and would therefore be empirically and clinically relevant to the current childhood obesity epidemic. Children included in studies were 0-6 years old; studies that included older children were maintained if they analysed the preschool-aged children in isolation. Studies containing children below the age of two years were included to increase the number of articles meeting review criteria. Studies involving teenage mothers (< 18 years) were excluded. Children were normal developing (not born preterm, no physical
health problems that may impact on weight status). Studies including both mothers and fathers were included only if the influence of maternal variables was analysed separately. All study designs were included (e.g., cross-sectional, longitudinal, experimental, quantitative). Studies were included if they examined the relationships between at least one category of maternal psychopathology (depression, anxiety, self-esteem or body dissatisfaction) and at least one of the identified risk factors of pre-schooler obesity: either child weight outcomes (e.g., BMI, overweight or obese status), or nutrition/diet variables, or physical activity levels, or sedentary behaviours. For both cross-sectional and longitudinal papers, these outcomes will be referred to as risk factors, as they have been documented in previous studies as longitudinal contributors to child obesity (Southern, 2004; Taveras et al., 2010; Tremblay & Willms, 2003a; Viner & Cole, 2005). Studies that did not measure these outcomes were not included. Studies in which the researchers explicitly aimed to examine the impact of these maternal variables on risk for child underweight were excluded, as the current review focused exclusively on risks for pre-schooler overweight and obesity.

**Selection process.** Figure 2.1 shows the process of article selection; 2033 records were yielded from the search strategy outlined in Box 1. After removal of duplicates ($n = 743$), 1294 titles and abstracts were screened by PB, of which 1194 were excluded. Full-text articles were obtained for the remaining 100 articles and read by PB and HS; from these a further 80 were excluded for the reasons outlined in Figure 2.1. This left 18 studies eligible for review. A further two studies that were known to the authors were included, making a total of 18 studies included for review.
Figure 2.1. PRISMA flow diagram of article selection.
Summary of Included Studies

Eligible studies are summarised below in Table 1. Study aims and design, sample characteristics, measures and main findings are summarised in Table 1, and will not be repeated in the results section below.

Of the 20 studies included, four adopted cross-sectional designs (Burdette, Whitaker, Kahn, & Harvey-Berino, 2003; Duarte, Shen, Wu, & Must, 2012; Gross, Velazco, Briggs, & Racine, 2013; Surkan, Kawachi, & Peterson, 2008). Prospective longitudinal designs were adopted by the remaining 16 studies (Bronte-Tinkew, Zaslow, Capps, Horowitz, & McNamara, 2007; Ertel et al., 2012; Ertel, Koenen, Rich-Edwards, & Gillman, 2010; Fernald, Jones-Smith, Ozer, Neufeld, & DiGirolamo, 2008; Gaffney, Kitsantas, Brito, & Swamidoss, 2014; Grote et al., 2010; Guxens et al., 2013; Lumeng, Rahnama, Appugliese, Kaciroti, & Bradley, 2006; McLearn, Minkovitz, Strobino, Marks, & Hou, 2006a; Mistry, Minkovitz, Strobino, & Borzekowski, 2007; Morrissey, 2013; Phelan et al., 2011; Rodgers et al., 2013; Santos, Matijasevich, Domingues, Barros, & Barros, 2010b; Thompson & Bentley, 2012; Wojcicki et al., 2011), however for two of these papers (Lumeng et al., 2006; Mistry et al., 2007), only the cross-sectional analyses at pre-school age were considered in the present review, as the longitudinal data were measured at child age > 6 (i.e. not pre-school age). The follow-up periods of the longitudinal studies ranged from nine months to five years. Of the 20 studies, nine (45%) recruited nationally representative samples across several sites (Bronte-Tinkew et al., 2007; Duarte et al., 2012; Fernald et al., 2008; Gaffney et al., 2014; Grote et al., 2010; Lumeng et al., 2006; McLearn et al., 2006a; Mistry et al., 2007; Morrissey, 2013), although one of these studies (Fernald et al., 2008) included only low-income
mothers. The remaining 11 studies (Burdette et al., 2003; Gross et al., 2013; Phelan et al., 2011; Rodgers et al., 2013; Santos et al., 2010b; Surkan et al., 2008; Thompson & Bentley, 2012; Wojcicki et al., 2011) recruited participants from single cities, although all but one (Gross et al., 2013) of these recruited participants from multiple sites within the city of recruitment.

All studies (both cross-sectional and longitudinal) had approximately even child sex ratios, although three failed to report this (Duarte et al., 2012; Guxens et al., 2013; McLearn et al., 2006a). Child age ranged from two months to 6.1 years; age at which outcomes were measured varied widely across studies (see Table 1). Only two (Bronte-Tinkew et al., 2007; Santos et al., 2010b) of the 20 studies reported robust designs (longitudinal design, objective measurement of child obesity risk factors, large sample size, controlled for covariates, and < 30% attrition). However, all but one study (Rodgers et al., 2013) adjusted for known covariates. This study reported that in their sample, maternal BMI was correlated with lower education and family income, and restrictive feeding was associated with lower parental education, however only maternal BMI was included as a covariate in their final model. The most commonly reported covariates were maternal BMI, age, education, marital status, smoking, measures of income/socio-economic status, and child sex. The majority (75%) utilised objective measures of pre-schooler obesity risks (i.e. did not rely on parental report), and 13 of the 20 studies comprised sample sizes larger than 500 participants. However, of the 14 longitudinal studies, only five (36%) had attrition rates less than 30% at follow-up. The highest reported attrition rate was 74.5% at two-year follow-up (Ertel et al., 2012), and the lowest was 4.3% at 3-month follow-up (Santos et al., 2010b). Attrition ranged between 15-40% for the majority of studies (Bronte-Tinkew et al., 2007; Ertel et al., 2012; Fernald et al., 2008; Gaffney et
al., 2014; Guxens et al., 2013; Phelan et al., 2011; Thompson & Bentley, 2012). Four studies reported attrition of more than 50% (Ertel et al., 2012; Grote et al., 2010; McLearn et al., 2006a; Morrissey, 2013), and two reported 10% or less (Santos et al., 2010b; Wojcicki et al., 2011). Two studies used multiple imputation methods to estimate missing data (Ertel et al., 2012; Guxens et al., 2013) and provided separate analyses for completers-only and imputed data sets. Five studies used completer-only data (Fernald et al., 2008; Gaffney et al., 2014; McLearn et al., 2006a; Mistry et al., 2007; Morrissey, 2013) whilst the remainder of studies did not report how missing data were handled. One study failed to report attrition rates (Rodgers et al., 2013).

Pre-schooler weight outcomes (either BMI/weight-for-age/weight-for-height z-scores, BMI percentiles, measures of adiposity, or categories of overweight/obesity) were measured by the majority of studies \((n = 16)\). Pre-schooler overweight/obese status was analysed categorically in nine of the 15 studies measuring child weight variables (Bronte-Tinkew et al., 2007; Ertel et al., 2012; Gross et al., 2013; Guxens et al., 2013; Lumeng et al., 2006; Santos et al., 2010b; Surkan et al., 2008; Thompson & Bentley, 2012; Wojcicki et al., 2011), while the remainder analysed child weight as a continuous variable (Duarte et al., 2012; Ertel et al., 2010; Gaffney et al., 2014; Grote et al., 2010; Phelan et al., 2011; Rodgers et al., 2013). Rather than measuring child weight outcomes, the remaining four studies (Burdette et al., 2003; McLearn et al., 2006a; Mistry et al., 2007; Morrissey, 2013) examined maternal-reported daily television viewing time as a measure of sedentary behaviour, an identified risk for pre-schooler overweight/obesity in our review. Lumeng et al. (2006) and Fernald et al. (2008) also measured maternal-reported daily TV viewing time as a measure of sedentary behaviour, in addition to pre-schooler weight outcomes. Fernald et al. (2008) was the only study to measure child physical activity levels as a pre-schooler
obesity risk outcome, measured via maternal report using the International Physical Activity Questionnaire (Sirard & Pate, 2001). Only one study (Thompson & Bentley, 2012) measured pre-schooler diet/nutrition variables, examining whether age-inappropriate feeding practices mediated the relationship between maternal depressive symptoms and child weight outcomes.

Pre-schooler overweight/obese status was analysed categorically in nine of the 15 studies measuring child weight variables (Bronte-Tinkew et al., 2007; Ertel et al., 2012; Gross et al., 2013; Guxens et al., 2013; Lumeng et al., 2006; Santos et al., 2010b; Surkan et al., 2008; Thompson & Bentley, 2012; Wojcicki et al., 2011), while the remainder analysed child weight as a continuous variable (Duarte et al., 2012; Ertel et al., 2010; Gaffney et al., 2014; Grote et al., 2010; Phelan et al., 2011; Rodgers et al., 2013).

Of the 20 studies, all but one (Rodgers et al., 2013) examined relationships between maternal depressive symptoms and identified pre-schooler overweight/obesity risk factors. Of these studies, all employed self-reported measures of depressive symptoms; one of these (Wojcicki et al., 2011) additionally utilised a clinical interview to determine the presence of clinical major depression or dysthymia. Details of the measures used to assess maternal depressive symptoms are listed in the study tables and will not be repeated here. The prevalence of depressive symptoms was reported in all but two studies (Lumeng et al., 2006; Phelan et al., 2011), and ranged from 7% to 55%. Most studies reported between 10 and 30% of their sample evidencing depressive symptoms. Other measures of maternal psychopathology included the anxiety, hostility, and global severity index subscales
of the Brief Symptom Inventory. Only one study (Rodgers et al., 2013) examined maternal body dissatisfaction. No studies measured maternal self-esteem.

Measurement points of maternal depressive symptoms in the 14 longitudinal studies varied. Four studies measured at a single time-point only: one at child age two months, (Gaffney et al., 2014), one at child age two years (Rodgers et al., 2013), and two during pregnancy (Guxens et al., 2013; Phelan et al., 2011). Three measured both during pregnancy and post-natally: one during the second and third trimesters and 4-6 weeks postpartum (Wojcicki et al., 2011), one at approximately 28 weeks gestation, and 6 and 12 months postpartum (Ertel et al., 2010), and one at approximately 20 weeks gestation, and 2 and 6 months post-partum (Ertel et al., 2012). Five studies measured only post-natal depressive symptoms: one at child age 15 months and 4-6 years (Fernald et al., 2008); one at 2, 3, and 6 months post-partum (Grote et al., 2010); one at child age 9 months and 24 months (Bronte-Tinkew et al., 2007); one at child age 2-4 months and 30-33 months (McLearn et al., 2006a), one at child ages 3, 6, 9 and 12 months (Thompson & Bentley, 2012); one annually from child age 1 through to 4 years (Morrissey, 2013), and one at child age 12, 24 and 48 months (Santos et al., 2010b).

Results of Studies Included for Review

Cross-sectional Relationships Between Maternal Depressive Symptoms and Child Obesity Risks

Of the six studies reporting cross-sectional analyses, five (Burdette et al., 2003; Gross et al., 2013; Lumeng et al., 2006; Mistry et al., 2007; Surkan et al., 2008) noted significant positive associations between postnatal maternal depressive symptoms and pre-schooler obesity risk factors. Two studies reported that pre-
schooler overweight/obese weight status was related to moderate-severe maternal depressive symptoms (Gross et al., 2013; Surkan et al., 2008). Duarte et al. (2012), conversely reported that severe maternal depressive symptoms were not related to BMI-z scores in boys, but were negatively related to BMI-z scores in girls, that is, reduced risk of overweight/obesity. However, this study only contained a small amount of mothers with severe depressive symptoms: 9%, based on a cut-off score of ≥15 on the Centre for Epidemiological Studies - Depression Scale [CES-D] (Radloff, 1977). Given that all other cross-sectional studies reported a prevalence of 30% or greater of their sample reporting depressive symptoms, Duarte et al.’s (2012) study may have a restricted range of maternal depressive symptoms.

Interestingly, these three studies all controlled for the same covariates (family SES, maternal education and marital status, and child ethnicity), however Duarte et al. (2012) controlled for covariates prior to analysis, whilst Surkan et al. (2008) and Gross et al. (2013) analysed the relationship between maternal depressive symptoms and pre-schooler weight outcomes both before and after adjustment, and found significant relationships even after adjustment. Thus it is unclear if Duarte et al. (2012) may have found significant results prior to covariate adjustment. Surkan et al. (2008) and Gross et al. (2013) also controlled for additional covariates which Duarte et al. (2013) did not, including: child sex, parity (both studies); child insurance level (Gross et al., 2013); breast-feeding duration, child birth weight, sanitation level, and recent child illness (Surkan et al., 2008). Based on this analysis, it may be possible that unmeasured covariates within Duarte et al.’s (2012) study prevented a significant relationship between maternal psychopathology and child BMI-z being found. Despite these three studies controlling for ethnicity and SES, it’s also interesting that Surkan et al. and Gross et al.’s samples were predominantly comprised of low-income
ethnic minorities, whilst over half of Duarte et al.’s sample were Caucasian American. Furthermore, Duarte et al. (2012) report mean SES scores based on a composite of annual family income, parent marital status and maternal education, however they fail to provide a frame of reference for this mean, thus the average SES of their sample is unknown. Mixed findings between the above studies, in addition to their cross-sectional design, leave the relationship between maternal depressive symptoms and pre-schooler overweight/obesity unclear.

Three of the cross-sectional studies reported associations between maternal depressive symptoms and high TV viewing time, that is, ≥ 2 hours per day (Burdette et al., 2003; Lumeng et al., 2006; Mistry et al., 2007). Gross et al. (2013) found no relationship between maternal depressive symptoms and preschooler TV viewing time, but did report pre-schoolers of mothers with moderate-severe depressive symptomology had less outdoor play time (i.e., more sedentary behaviour). Gross et al. (2013) used the Patient Health Questionnaire (Kroenke, Spitzer, & Williams, 2001) to assess maternal depressive symptoms, as opposed to the CES-D (Radloff, 1977), which was used in all the other cross-sectional measuring depressive symptoms. The sample used in Gross et al.’s study was drawn exclusively from a single, low-income community health centre in the Bronx, New York City, whilst Lumeng et al. (2006) and Mistry et al. (2007) recruited nationally representative samples from several sites across the United States. Burdette et al. (2003), however, recruited their sample from a single state in the US, although they recruited across four different sites. Gross et al.’s participants were also predominantly Hispanic and Black, whereas the participants in Lumeng et al.’s (2006) and Mistry et al.’s (2007) studies were predominantly Caucasian; Burdette failed to report ethnicity distribution.
in their sample. Therefore, Gross et al.’s (2013) null findings may only extend to low-income, Hispanic and Black samples of mothers and pre-schoolers.

With regard to covariates, all three studies controlled for maternal age, education, and marital status. However, Burdette et al. (2003) was the only study to control for maternal BMI and smoking status, but failed to control for ethnicity. Conversely, Gross et al. (2013) and Mistry et al. (2007) both controlled for ethnicity, and additionally for parity, and maternal employment status. Mistry et al. (2007) was the only study of the three to control for family income, and additionally controlled for child health status and parental involvement in child activities. Burdette et al. (2003) and Gross et al. (2013) controlled for child sex, however Mistry et al. (2007) did not. Interestingly, Burdette et al. (2003) reported that the relationship between maternal depressive symptoms and child TV viewing time became significant only after controlling for maternal education. Mistry et al. (2007) treated maternal depressive symptoms as a covariate in their final model, thus it is unknown whether a significant relationship to child TV viewing exists when other covariates are controlled. In Gross et al.’s study, child TV viewing was not related to depressive symptoms either before or after covariate adjustment, however less outdoor playtime was related to depressive symptoms in both adjusted and unadjusted models. Given the discrepancy between studies in the covariates included, it is difficult to determine if or how covariates influence the relationship between maternal psychopathology and pre-schooler obesity risk at a cross-sectional level. Furthermore, whilst the findings of the above studies provide some insight into the relationships between maternal psychopathology factors and pre-schooler obesity risks, they are evidently limited by their cross-sectional nature, preventing causal associations from being drawn. The remainder of the review will focus on longitudinal assessments of these relationships.
Longitudinal Relationships Between Maternal Depressive Symptoms and Child Weight Outcomes as Risks for Pre-schooler Obesity

Longitudinal studies revealed mixed findings for the association between maternal depressive symptoms and pre-schooler overweight/obesity risks; 11 of the 14 studies (78.5%) found at least partial support for an association between maternal depressive symptoms and pre-schooler overweight/obesity risk factors (Bronte-Tinkew et al., 2007; Ertel et al., 2012; Ertel et al., 2010; Fernald et al., 2008; Gaffney et al., 2014; Grote et al., 2010; Guxens et al., 2013; McLearn et al., 2006a; Morrissey, 2013; Santos et al., 2010b; Thompson & Bentley, 2012). Weight-related risk factors included: greater central adiposity (ratio of subscapular [SS] and triceps [TR] skinfold thickness) and overall adiposity (Ertel et al., 2010), higher weight in kilograms compared to children of mothers with no depressive symptoms (Gaffney et al., 2014; Grote et al., 2010), higher weight for age z-scores (Santos et al., 2010b), higher BMI (Guxens et al., 2013) and BMI-z scores (Ertel et al., 2012).

It should be noted, however, that whilst Ertel et al. (2010) found maternal depressive symptoms predicted pre-schooler adiposity, they also found antenatal depressive symptoms predicted lower weight-for-height z-scores at age three and that neither antenatal nor postnatal depressive symptoms predicted pre-schooler overweight status (BMI ≥85th percentile). Additionally, even though Ertel et al. (2012) reported that both maternal antenatal and postnatal depressive symptoms were significant predictors of child BMI z-scores at age 3, after controlling for covariates (including maternal age, education, ethnicity, parity, income, marital status, self-reported smoking and alcohol consumption during pregnancy, and history of depression), the relationships attenuated to non-significance. Similarly, after controlling for covariates (including maternal education, ethnicity, age, smoking
during pregnancy, parity, partner status, and maternal and paternal BMI), Guxens et al. (2013)’s findings also became non-significant. It should also be noted that in their unadjusted analyses, maternal depressive symptoms were only related to higher child BMI at ages 3 months and 6 months, but not at later ages (12, 18, 24, 36 and 48 months). Furthermore, whilst finding chronic maternal depressive symptoms (across three measurement points) predicted pre-schooler overweight at age four, Santos et al. (2010b) also found a three-fold increased risk of underweight in children of these mothers. However, their sample was drawn entirely from a single Brazilian city, thus results may only extend to women of Brazilian ethnicity. Similarly, the samples of Ertel et al. (2010), Ertel et al. (2012) and Thompson and Bentley (2012) were all drawn from single cities, as opposed to the remainder of the included longitudinal studies, which recruited participants across several geographical locations to obtain nationally representative samples.

The remaining three longitudinal (21%) studies found maternal depressive symptoms had no association with pre-schooler overweight and obesity (Bronte-Tinkew et al., 2007; Phelan et al., 2011; Wojcicki et al., 2011). Wojcicki et al. (2011) additionally found maternal depressive symptoms to be associated with decreased odds of child overweight and obesity, which is similar to the findings of Santos et al. (2010). Of note, Phelan et al. (2011) did not report the prevalence of mothers experiencing elevated depressive symptomology in their study. Thus, it is unclear whether Phelan et al.’s (2011) sample comprised a sufficient percentage of mothers experiencing depressive symptomology to adequately test the relationship between pre-schooler obesity risk and maternal psychopathology. Wojcicki et al. (2011) and Bronte-Tinkew et al.’s (2007) studies on the other hand, included women with a higher prevalence of depressive symptoms (22.5% and 32.7% respectively), and
employed rigorous methodology, analysing the presence of depressive symptomology dichotomously (i.e., comparing mothers with and without symptoms) within logistic regression and structural equation models, respectively. These studies both reported null findings after adjustment for covariates, and Wojcicki et al. (2011) also reported null findings prior to adjustment. Importantly, Wojcicki et al. (2011) was the only study within this present review that utilised clinical interviews to determine the presence of maternal clinical depression, and found this was not associated with pre-schooler weight outcomes. However, this study also utilised a sample of exclusively Latina women, suggesting that these findings may not generalise to other ethnicities. Given that both Santos et al. (2010) and Wojcicki et al. (2011) utilised samples of women with Latina background, and both found maternal depressive symptoms to have a negative relationship to the risk of pre-schooler obesity, it appears ethnicity may have a strong mediating effect on this relationship. Nonetheless, the results of both Wojcicki et al. (2011) and Bronte-Tinkew et al. (2007) demonstrate evidence against a link between maternal depressive symptoms and pre-schooler obesity risks. Taken together, the results of the longitudinal studies suggest the relationship between maternal depressive symptoms and pre-schooler weight outcomes are complex and may place the child at risk of both underweight and overweight.

**Longitudinal relationships between maternal depressive symptoms and lifestyle risk factors for pre-schooler obesity.** In addition to weight outcomes, three of the longitudinal studies (Fernald et al., 2008; McLearn et al., 2006a; Thompson & Bentley, 2012) examined relationships between lifestyle obesity-promoting risk factors and maternal depressive symptoms, all reporting significant associations. Fernald et al. (2008) found mothers’ depressive symptoms at child age 15 months
significantly predicted low child physical activity levels at baseline measurement and at follow-up when the child was aged 4-5 years, in both unadjusted and adjusted analyses (controlling for child gender, age, weight status, maternal physical activity, BMI and SES). Low child physical activity levels were also significantly related to higher TV viewing time (≥10 hours per week). It should be noted that this study comprised a low-income, low-education sample of Mexican women and children, thus results may not generalise to populations of differing ethnicity and socioeconomic status. The sample was also small (n = 163) considering the authors’ use of regression analysis. However it is noteworthy these findings were independent of covariate influence.

McLearn et al. (2006a) found that maternal depressive symptoms measured at child age 2-4 months and 30-33 months significantly predicted daily child TV/video viewing (sedentary behaviour) ≥2 hours at age 30-33 months, although the associations at child age 2-4 month became non-significant after covariate adjustment. There was also no evidence for a cumulative effect of chronic depression (over two time points) on child TV viewing time. This study draws strength in its large sample size and a heterogeneous ethnic sample (Caucasian, Black and Hispanic), however the findings are weakened by associations only being significant cross-sectionally, not longitudinally. Child TV viewing time was also measured based on maternal report rather than objective observation, thus may not reflect accurate television exposure in this sample.

Thompson and Bentley (2012) found that maternal depressive symptoms were associated with higher odds of age inappropriate feeding at all measurement points (child age 3, 6, 9 and 12 months of age), however this relationship became non-significant in the fully adjusted models (controlling for maternal age, BMI, marital
status, work status, education, child age and sex, whether child was breastfed, and repeated measures across subjects). Age inappropriate feeding was also related to higher odds of high WFL percentiles across infancy (in adjusted models) compared to infants fed according to recommendations. However, these results must be interpreted with caution as the sample size was notably small ($n = 217$) for the analyses employed (logistic regression), and age inappropriate feeding was based on maternal report, rather than objective measurement.

In summary, the longitudinal studies were all characterised by generally strong methodology (large sample sizes, nationally representative samples, objective measurements of child weight outcomes, control of covariates, and acceptable attrition rates). While partial support for a relationship between maternal depressive symptoms and pre-schooler obesity risk was found, not all studies provided strong evidence for this association. Therefore, these findings must be interpreted with caution.

**Timing of maternal depressive symptom measurement and pre-schooler obesity risks.** There appeared to be an interaction of the time-point at which maternal depressive symptoms were measured on the relationship between mothers’ depressive symptoms and pre-schooler obesity risks, however this varied greatly across studies (both longitudinal and cross-sectional). Only two studies measured depressive symptoms pre-natally only; one reported that pre-natal depressive symptoms did not significantly predict child weight-for-age $z$-scores at 6 months post-partum (Phelan et al., 2011), whilst the other reported pre-natal depressive symptoms predicted higher child BMI at age 3 and 6 months, and also predicted child overweight status at age 4 years (Guxens et al., 2013).
Of the several studies that measured maternal depressive symptoms both pre- and post-natally, results were mixed. Ertel et al. (2010) noted differential predictions of pre-schooler weight outcomes between antenatal and postnatal measurements of maternal depressive symptoms: AND and PND both predicted higher central adiposity in children at age three, however AND also predicted lower child BMI-z and WHZ, while PND did not predict any other child weight outcomes. Neither AND nor PND predicted child BMI ≥85th percentile (overweight) or ≤15th percentile (underweight). After adjusting for covariates, Ertel et al. (2012) reported only post-natal depressive symptoms measured two months after birth were significantly predictive of child BMI-z, whilst prenatal and six-month post-natal depressive symptoms became non-significant predictors. Wojcicki et al. (2011) found no relationship between maternal depressive symptoms and pre-schooler weight outcomes either ante-natally or 12 months post-natally.

Of studies measuring depressive symptoms post-natally only, results were again mixed. Two of the studies found no relationship between maternal depressive symptoms and pre-schooler obesity risk; one measuring depressive symptoms at child age 9 months and depressive symptoms at child age 15 months (Bronte-Tinkew et al., 2007), and the other measuring both variables at child age 6 years (Duarte et al., 2012). With the exception of Duarte et al. (2012), all the cross-sectional studies included for review reported significant relationships between maternal depressive symptoms and pre-schooler obesity risks, with measurement ranging between child age 5-25 months (Surkan et al., 2008), 30-33 months (Mistry et al., 2007), 36 months (Lumeng et al., 2006), 46 months (Burdette et al., 2003), and 5 years (Gross et al., 2013).
The remaining longitudinal studies measuring post-natal depressive symptoms only (with the exclusion of Bronte-Tinkew et al., 2007), all reported some significant associations between maternal depressive symptoms and pre-schooler obesity risks, however, the patterns were less clear. Thompson and Bentley (2012) noted that maternal depressive symptoms at baseline measurement (child age 3 months) significantly predicted inappropriate child feeding practices at child age 6, 9, 12, and 18 months, which in turn predicted high child weight-for-length scores. Gaffney et al. (2014) found depressive symptoms at child age 2 months predicted significantly greater weight gain at child age 6 months.

Interestingly, Grote et al. (2010) found significant associations only for mothers who entered the study with elevated postnatal depressive symptoms scores that had resolved at 12-month measurement, while those who still had elevated depressive symptoms at 12 months showed no associations with pre-schooler weight. Fernald et al. (2008) found that maternal depressive symptoms measured at child age 15 months, predicted significantly lower child physical activity at age 3-4 years, but symptoms measured at child age 3-4 did not cross-sectionally predict lower child physical activity. Santos et al. (2010b) found no significant associations of pre-schooler obesity risks to maternal depressive symptoms at individual time-points, however, when examining chronic depressive symptoms (i.e., elevated scores at all three time-points on the EPDS), odds ratios for child overweight were 1.3 times higher than in children of mothers without chronic depressive symptoms. Morrissey (2013) also reported significant association between greater duration of maternal depressive symptoms (present at more than one measurement points, from child age 9 months to 2, 3 and 4 years) and higher child TV viewing time at ages 2, 3 and 4 years. Morrissey (2013) also reported a significant relationship between maternal moderate-
severe depressive symptoms at any time-point and high child TV viewing time, however depressive symptoms were pooled within the analysis, thus it is unclear if specific time-points were more likely than others to increase the risk for pre-schooler obesity. Conversely, McLearn and colleagues (2006a) reported no interaction effect of time on the relationship between maternal depressive symptoms and child TV viewing time, i.e. chronic depression across both time-points was not related to pre-schooler obesity risks, despite this relationship being significant at individual measurements.

**Longitudinal relationships between other types of maternal psychopathology and risk for pre-schooler overweight and obesity.** A minority of studies included for review (n = 2) examined maternal psychopathology variables other than depressive symptoms. Guxens et al. (2013) measured maternal anxiety, hostility, and global severity of psychological symptoms, and found these variables significantly predicted child overweight and obesity at age four. However, after adjusting for maternal ethnicity, associations were no longer significant. This sample contained small percentages of mothers reporting these symptoms, suggesting possible range restriction of maternal psychopathology measurement; however the study did comprise a large sample (≥ 5000 participants. Thus results are likely to be accurate for the specific population measured. Rodgers et al. (2013) was the only study that measured maternal body dissatisfaction; Spearman correlations revealed no significant relationships between maternal body dissatisfaction and child BMI z-scores at baseline or 12-month follow-up, or with BMI-z change scores (between baseline and follow-up). However, path analyses found a significant indirect positive effect of maternal body dissatisfaction on child BMI-z change at 12 months, in an upward direction, via maternal dietary restraint. It must be noted that the path model
as a whole accounted for only 3% of the total variance in child BMI-z change at 12 months, thus the strength of association between maternal body dissatisfaction and pre-schooler obesity risk must be interpreted with caution in this study. The sample size was also small ($N = 220$) and below the requirements of path analysis.

**Analysis of Study Findings**

Despite wide variation in child age range across studies, there were no consistent relationships between this variable and study outcomes. While two studies with children younger than two years of age reported non-significant relationships between maternal psychopathology indices and pre-schooler overweight/obesity risk (Phelan et al., 2011; Wojcicki et al., 2011), four others (Fernald et al., 2008; Gaffney et al., 2014; McLearn et al., 2006a; Thompson & Bentley, 2012) reported significant results despite including children as young as 6-15 months in their sample. Furthermore, Surkan et al. (2008) found a significant association between maternal depressive symptoms and weight outcomes in children as young as 6-12 months, but in comparison, children aged 12-18 months were less likely to have WHZ scores above the 85th and 95th percentiles. In contrast, (Duarte et al., 2012) found no significant cross-sectional relationships maternal depressive symptoms and pre-schooler weight outcomes in children aged up to four years. The disparity across study findings suggests that age may have a complex relationship, if any, with pre-schooler obesity risk factors. Furthermore, the time at which maternal depressive symptoms were measured revealed no consistent pattern to whether they were related to pre-schooler obesity risk outcomes, with pre-natal and post-natally measured maternal depressive symptoms showing both significant and non-significant associations to pre-schooler obesity risks. Based on these mixed results across studies,
it is unclear whether there is a specific time-point in the pre-schooler’s life at which maternal depressive symptoms should be measured to best predict obesity risk.

With regard to adjustment for covariates, findings also varied across studies. Eleven of the 20 studies (55%) reported significant relationships between maternal psychopathology indices and pre-schooler overweight/obesity risks even after adjusting for covariates (Burdette et al., 2003; Ertel et al., 2010; Fernald et al., 2008; Gaffney et al., 2014; Gross et al., 2013; Grote et al., 2010; Morrissey, 2013; Phelan et al., 2011; Rodgers et al., 2013; Santos et al., 2010b; Surkan et al., 2008). The most frequently included covariates were (percentages of studies including these covariates in parentheses): maternal education (75%), maternal marital status (70%), age (65%), ethnicity (60%), maternal BMI (55%), family income (55%), child sex (55%), and maternal smoking status (40%). One study (Burdette et al., 2003) reported no relationship between maternal depressive symptoms and pre-schooler overweight/obesity risks until adjusting for maternal education and BMI. Four studies (20%) noted the relationship between maternal depressive symptoms and pre-schooler overweight/obesity risks attenuated to non-significance following covariate adjustment (Ertel et al., 2012; Guxens et al., 2013; Phelan et al., 2011; Thompson & Bentley, 2012). Similar to the studies reporting significant associations after covariate adjustment, these studies commonly controlled for maternal age, education, marital status, smoking, and child sex. Thus the underlying influence of these covariates is unclear, as studies both reporting significant and non-significant findings employed the same covariates in their analyses. Of note, two of these studies (Ertel et al., 2012; Guxens et al., 2013) reported maternal ethnicity being the strongest influencing covariate.
Interestingly, two of the 20 studies (McLearn et al., 2006a; Santos et al., 2010b) reported both significant and non-significant results after covariate adjustment. For Santos et al. (2010b), relationships between chronic maternal depressive symptoms and pre-schooler weight status remained significant, whilst single measurement of maternal depressive symptoms at follow-up did not. Covariates included maternal age, ethnicity, education, marital status, smoking status, pre-pregnancy BMI, family income, and health care use. McLearn et al. (2006a) reported the relationship between maternal depressive symptoms and high child TV viewing time was no longer significant after adjusting for covariates (maternal education, marital status, ethnicity, and family income) when the child was 2-4 months old, however measurement at child age 30-33 months revealed significant relationship between these variables even after covariate adjustment. Two studies (Lumeng et al., 2006; Mistry et al., 2007) found maternal depressive symptoms were related to pre-schooler TV viewing time in initial analyses, but treated maternal depressive symptoms as a covariate in their final analyses, thus it is not clear whether depressive symptoms were associated independently with pre-schooler overweight/obesity risks. Three studies (Bronte-Tinkew et al., 2007; Duarte et al., 2012; Wojcicki et al., 2011) reported no significant relationships between maternal depressive symptoms and pre-schooler overweight/obesity risks either before or after covariate adjustment.

Findings between studies also differed depending whether pre-schooler overweight/obesity was analysed categorically (i.e. by weight status), as opposed to continuously. For example, two studies (Ertel et al., 2012; Ertel et al., 2010) found that maternal depressive symptoms predicted greater child adiposity and higher child BMI-z scores respectively, however it did not predict child overweight/obese status.
Conversely, Santos et al. (2010b) found no association between maternal chronic depressive symptoms and child WFA-z scores (analysed continuously), however they found maternal chronic depressive symptoms were associated with pre-schooler overweight status. Of the nine studies categorically analysing relationships between maternal depressive symptoms and pre-schooler overweight/obese status, five (55%) found significant associations (Gross et al., 2013; Guxens et al., 2013; Santos et al., 2010b; Surkan et al., 2008; Thompson & Bentley, 2012), and one (Guxens et al., 2013) additionally noted significant predictions of pre-schooler overweight status at four years by maternal overall psychopathology, anxiety and hostility. However, five (83%) of the six studies analysing pre-schooler weight outcomes continuously also noted significant relationships to maternal depressive symptoms (Ertel et al., 2012; Gaffney et al., 2014; Grote et al., 2010), body dissatisfaction (Rodgers et al., 2013). Based on these results, the optimal mode of analysis of child weight variables is thus unclear.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Participant characteristics</th>
<th>Study design, setting and outcome measures</th>
<th>Study aim(s)</th>
<th>Measures of maternal psychopathology and prevalence of clinically significant scores</th>
<th>Main findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bronte-Tinkew et al. 2007</td>
<td>$n = 8693$</td>
<td>Design: Prospective longitudinal</td>
<td>A longitudinal study examining direct and indirect associations (including maternal depression) between food insecurity, physical health and overweight status in pre-school aged children.</td>
<td>Measure: 12-item abbreviated version of the Centre for Epidemiological Studies – Depression Scale [CES-D] (Radloff, 1977) Measurement points: Completed at baseline only (infant age 9 months) Cut-off score: $\geq 5$ used to indicate mild – severe depressive symptoms; anything</td>
<td>In the full structural equation model (adjusted for covariates), depression did not have an effect on overweight. It did however, mediate the relationship between food insecurity and child physical health, where food insecure households were more likely to have depressed mothers, and in turn more likely to have children with poorer physical health (thus depression predicted physical health). Covariates included were: maternal age at infant birth,</td>
</tr>
<tr>
<td>USA</td>
<td>% male children: 51.1%</td>
<td>Follow-up: 15 months (child age 24 months)</td>
<td>Measurement points: baseline (child age 9 months) and follow-up (child age months 24) Study setting: questionnaires &amp; assessments completed in participants homes Main outcome measure: child overweight status (calculated using the CDC overweight percentiles: weight for length $\geq 95^{th}$ percentile</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Mean maternal age (at child’s birth): 27.5 ($SD = 6.4$)</td>
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</tr>
<tr>
<td></td>
<td>Mean child age (at study baseline): 10.5 months ($SD = 1.9$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean maternal BMI: not reported</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Mean child BMI: Not reported; 17.8% were overweight at follow-up (age 15 months)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ethnicity: Not reported</td>
<td></td>
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</tr>
</tbody>
</table>
### Burdette et al. 2003

**Vermont, USA**

- **n = 295** mother-child dyads
- **55%** male children
- **Mean maternal age:** 30 years (SD = 6 years)
- **Mean child age:** 46 months (SD = 8 months)
- **Mean maternal BMI:** 27 (SD = 7); 12% obese (BMI ≥ 30)
- **Mean child BMI:** not reported
- **Ethnicity:** 92% Caucasian
- **Attrition:** N/A

#### Design
- **Follow-up:** N/A
- **Measurement points:** N/A
- **Study setting:** Women Infant Child clinics, urban and rural
- **Main outcome measure:** Children’s TV viewing time. Measured via maternal report using two questions: 1) “How much time would you say your child spends watching TV on a typical weekday?” 2) “How much time would you say your child spends watching TV on a typical weekend day?”

To examine the relationship between maternal obesity, maternal depressive symptoms and preschooler’s TV viewing time in a low-income sample, T-tests found that children of mothers that had either elevated depressive symptoms \( p < .05 \) or were obese \( p < .01 \) mothers watched significantly more TV daily than children of mothers without elevated depressive symptoms or obesity.

Regression analyses showed that children of mothers with elevated depressive symptoms watched an average of 23 minutes more TV per day (95% CI, 4-42 minutes) compared to children of mothers without elevated scores.

**Measure:** CES-D (Radloff, 1977)
- **Measurement points:** N/A
- **Cut-off score:** ≥ 16 to indicate elevated depressive symptoms
- **Prevalence:** Mean score = 13 (SD = 11); 31% obtained scores ≥ 16

#### Attrition
- **15%** (classified as overweight) below coded as no symptoms
- **Prevalence:** 37.2% scored ≥ 5

#### Attrition
- **55%** male children
- **Mean maternal age:** 30 years (SD = 6 years)
- **Mean child age:** 46 months (SD = 8 months)
- **Mean maternal BMI:** 27 (SD = 7); 12% obese (BMI ≥ 30)
- **Mean child BMI:** not reported

**Ethnicity:** 92% Caucasian
recorded as hours and minutes.

both elevated depressive symptoms and obesity showed the greatest amount of TV viewing time (50 minutes more per day than children of mothers who did not have elevated symptomology or were obese. Compared with the three other groups (children of neither obese nor mothers with elevated symptomology; children of depressed but not obese mothers; and children of obese but not depressed mothers), children of mothers with both elevated depressive symptoms and obese status has significantly greater TV-viewing time ($p < .01$; analysis controlled for maternal education, maternal marital status, smoking status, age).

| Duarte et al. 2012 | USA | $n = 21,260$ mother-child dyads | Design: Cross-sectional. N.B. this study is To examine the association | Measure: 12 item CES-D (Radloff, No significant relationships were present between boys |
% male children not reported
Maternal age, BMI and ethnicity not reported

Mean child age:
boys - $M = 74.84$ months (SD = 0.15);
girls - $M = 74.45$ months (SD = 0.13)

Mean maternal BMI: not reported
Mean child BMI-z:
boys: $M = 0.42$ (SD = 0.03); girls: $M = 0.38$ (SD = 0.03)

Child ethnicity:
boys - 57.11% Caucasian, 15.42% African-American; 19.74% Hispanic, 7.73% other; girls - 55.09% Caucasian, 16.54% African-American, 20.47% Hispanic, 7.91% other

Attrition: N/A

Ertel et al. 2010 n = 838 mother child

Design: Prospective
To prospectively
Measure: Edinburgh Regression found maternal

BMI-z and maternal depressive symptoms (any of the 4 categories) at age 6. For girls, there was a significant relationship; daughters of severely depressed mothers had the smallest BMI-z scores (BMI-z mean = 0.13, $p < 0.01$). Analyses were adjusted for family socioeconomic status (composite score based on annual family income, marital status, and maternal education) and child ethnicity.
<table>
<thead>
<tr>
<th>Boston, USA dyads</th>
<th>longitudinal Follow-up: 3 years</th>
<th>examine the relationships of antenatal and postpartum depression with child weight and adiposity at age 3, and with change in weight from birth to age 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>47.8% male children</td>
<td>Mean maternal age (at study entry): 32.97 (SD = 4.46)</td>
<td>Maternal BMI range (pre-pregnancy): 32.5% &lt; 25, 67.5 &lt; 25; 50% had excessive weight gain during pregnancy</td>
</tr>
<tr>
<td>Child mean age (in months; at 3-year follow-up): 38.96 (SD = 3.23)</td>
<td>Mean child BMI-z (at 3-year follow-up): 0.45 (SD = 1.01);</td>
<td>Maternal BMI range (pre-pregnancy): 32.5% &lt; 25, 67.5 &lt; 25; 50% had excessive weight gain during pregnancy</td>
</tr>
<tr>
<td>Ethnicity: 80.5% Caucasian, 7.8% African American, 11.7% other</td>
<td>Mean weight-for-height-z [WHZ] = 0.43 (SD = 0.97);</td>
<td>AND predicted lower child BMI-z at age 3 (&lt; -0.24, 95% CI: -0.49, 0.00), but greater central adiposity (M = 0.05, 95% CI: 0.01, 0.09) compared to children of mothers without AND.</td>
</tr>
<tr>
<td>Mean weight-for-height-z [WHZ] = 0.43 (SD = 0.97);</td>
<td>Study setting: obstetric practices</td>
<td>WHZ at age 3 was -0.24 (95% CI: -0.49, 0.00) mean units lower in children of mothers with AND; AND had no effect on SS + TR at age 3 (overall adiposity).</td>
</tr>
<tr>
<td>Maternal BMI range (pre-pregnancy): 32.5% &lt; 25, 67.5 &lt; 25; 50% had excessive weight gain during pregnancy</td>
<td>Main outcome measure: Child BMI, weight for height z-score (WHZ), subscapular plus triceps skinfold thickness (SS + TR; to measure overall adiposity) and SS:TR (to measure central adiposity) at 3 years</td>
<td>PND predicted greater central adiposity at age 3 (M = 1.14mm, 95% CI: 0.11, 2.18) in children of mothers with PND compared to non-PND children, but had no significant effect on any other child weight outcomes.</td>
</tr>
<tr>
<td>Ethnicity: 80.5% Caucasian, 7.8% African American, 11.7% other</td>
<td>Measurement points:</td>
<td>Neither AND nor PND were significant predictors of child BMI &gt; 85th percentile or &lt; 15th percentile.</td>
</tr>
<tr>
<td>Postnatal Depression Scale [EPDS] (Cox, Holden, &amp; Sagovsky, 1987)</td>
<td>Measurement points: mid-pregnancy (mean 28 weeks gestation - to assess antenatal depression [AND]), and 6 months and 1 year postpartum (to assess postnatal depression [PND]).</td>
<td></td>
</tr>
</tbody>
</table>
Attrition: 32.9%; no significant differences in completion rates between mothers with/without postnatal depressive symptoms or antenatal depressive symptoms; completer-only analysis used for pregnancy), 7% had PND (scoring above cut-off after pregnancy).

Findings were independent of child sex, maternal age, race/ethnicity, education, marital status and pre-pregnancy BMI, history of depression, smoking status, household income, BMI prior to pregnancy, and mid-pregnancy health conditions (i.e. corticotrophin releasing hormone levels, gestational weight gain & gestational diabetes). Regression analyses found neither maternal AND nor PND had effects on child WHZ, i.e. the strength of association did not change over time.

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Measurement</th>
<th>Measure</th>
<th>Completer only analysis:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ertel et al. 2012 Rotterdam, Netherlands</td>
<td>Prospective longitudinal</td>
<td>6-item Depression subscale of the Brief Symptom Inventory (BSI) (Derogatis &amp; Melisaratos, 1983)</td>
<td>6-item Depression subscale of the Brief Symptom Inventory (BSI) (Derogatis &amp; Melisaratos, 1983)</td>
<td>Initial model found elevated maternal depressive symptoms at all 3 time points predicted higher child BMI z at 3 years (p &lt; .05); In the adjusted model</td>
</tr>
<tr>
<td>n = 6782 mother child-dyads</td>
<td>To prospectively investigate maternal depression (pre and post-natal), and its relationship to child overweight longitudinally</td>
<td>Measurement points: 20.6 weeks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50.55% male children</td>
<td></td>
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</tr>
<tr>
<td>Mean maternal age: 30.25 (SD = 5.24)</td>
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<td></td>
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<tr>
<td>Mean child age (at 3 year follow-up):</td>
<td></td>
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</tbody>
</table>

Design: Prospective longitudinal Follow-up: 3 years post-partum Measurement points: child weight outcomes measured at birth and 3 year follow-up
27.09 months ($SD = 1.36$)

**Mean maternal BMI** (pre-pregnancy): 23.49 ($SD = 4.21$); mean weight gain during pregnancy = 10.41kg ($SD = 4.85$)

**Mean child BMI change** (at 3 year follow-up): .40 units ($SD = .97$);

Percentage overweight/obese not reported. BMI change presumably based on birth weight.

**Ethnicity**: 52.86% Dutch, 8% other European, 8% Surinamese, 8.5% Turkish, 7% Moroccan, 16.2% Other

**Attrition**: 74.5% at 2 months post partum; completers had 

| Study setting: pen and paper questionnaires mailed and completed at home |
| Main outcome measure: child BMI z-scores |
| gestation (average), 2 and 6 months post-partum; respondents answered according to symptoms present over the previous 7 days. |

**Cut-off score**: > 0.75 used to indicate elevated depressive symptoms

**Prevalence**: 10% of sample had elevated depressive symptoms at each time point when using MI data; 5-6% at each time-point when using completers only data

(controlling for maternal age, education, ethnicity, parity, income, marital status, self-reported smoking and alcohol consumption during pregnancy, and history of depression), the associations between child BMI-z and prenatal and 6 month postnatal depressive symptoms were no longer significant. PND at 2 months remained a large and significant predictor of child BMI-z at 3 years (β = .27, 95% CI: 0.08, 0.45, $p = 0.01$). Maternal ethnicity accounted for majority of the attenuation in effect.

**Multiple Imputation analysis**: elevated maternal depressive symptoms at any time-point was not associated with child BMI-z (in both adjusted and unadjusted models). PND at 2 months and maternal BMI
significantly lower depressive symptoms and socio-economic disadvantage scores; multiple imputation (MI) analysis used to replace missing data had a small significant association in the unadjusted model only. Again, ethnicity played a large role in attenuating these relationships, especially Turkish and Moroccan backgrounds, although there were no significant relationships between maternal depression, ethnicity, income and education. Further analyses of maternal depressive symptoms at all time-points and child weight categories (e.g. normal, overweight and obese) also showed no significant associations.

Fernald et al. 2008 Mexico

Design: Prospective longitudinal
Follow-up: approximately 3-4 years
Measurement points: baseline at child age 15mths (measurement of maternal depressive symptoms (measured at child age 15 months) were predictive of

To test a model hypothesising that high maternal depressive symptoms were predictive of

Measure: CES-D - Spanish version (Golding & Aneshensel, 1989) validated in Spanish-speaking Mexican and US populations;

Logistic regression: baseline maternal depression was a significant predictor of low child activity at follow-up (OR 2.26; 95% CI, 1.14, 4.47, p < .05), independent of covariates (after adjusting,
Low activity: 29.7 (SD = 6.0)
High activity: 28.4 (SD = 5.3)

Mean child age (measured at follow-up): 5.0 years (SD = 4.0)
Mean maternal BMI (by child activity level):
Low activity: 28 (SD = 5.2), 47% overweight, 35.7% obese
High activity: 27.7 (SD = 4.5), 36.8% overweight, 31.6% obese

Mean child weight variables (measured only at follow-up) – by activity level:
Low activity: BMI = 15.5 (SD = 1.2),

BMI-z = -0.03 (SD = 1.0), 2% overweight, 16.3% at risk for symptoms and demographic variables), follow-up at child age 4-6 years (measurement of maternal depressive symptoms, child physical activity, TV viewing, and anthropometry)

Study setting: not reported

Main outcome measure: child physical activity levels

Measured via maternal report on the International Physical Activity Questionnaire (Sirard & Pate, 2001), validated in children cross-nationally; used cut-off of <20mins vigorous activity <7 days per week to dichotomise low activity from high activity).

Other measures of low child physical activity at ages 4-6 years administered verbally by interviewer due to low literacy levels in the sample. Scale was modified to be appropriate for conditions of poverty within the sample, and the measure was piloted in another sample of women of low socioeconomic status.

Measurement points: child age 15 months, and between 4-6 years

Cut-off score: ≥16 used to indicate elevated depressive symptoms; in analyses scores were dichotomised in as depressed or not depressed (<16)

Prevalence (by OR 2.38, 95% CI, 1.05, 5.40, p < .05). High TV viewing time also an independent predictor of low activity (OR 5.44, 95% CI, 2.06, 14.3, p < .001) but did not attenuate the prediction by maternal depressive symptoms. Maternal depressive symptoms measured at follow-up were not related to child physical activity levels at follow-up. Covariates were child sex, age, and weight status; maternal physical activity, BMI and socio-economic status.
overweight

**High activity:** $BMI = 15.7$ ($SD = 1.2$), $BMI-z = .02$ ($SD = 0.9$), 7.6% overweight, 22.8% at risk for overweight

**Ethnicity:** Not reported, Mexican sample

**Attrition:** 27%; completers-only data used in analyses; no significant differences in demographics between those lost to follow-up and those with complete data at baseline and follow-up

<table>
<thead>
<tr>
<th>Gaffney et al.</th>
<th>2014 USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 1447 mother-child dyads</td>
<td>49.8% male</td>
</tr>
<tr>
<td>Mothers’ age range at study entry (in %; mean not reported):</td>
<td></td>
</tr>
<tr>
<td><strong>Design:</strong> Prospective longitudinal</td>
<td><strong>Follow-up:</strong> 4 months</td>
</tr>
<tr>
<td><strong>Measurement points:</strong> study entry and follow-up after 4 months (child)</td>
<td><strong>Measure:</strong> 10-item EDPS (Cox et al., 1987)</td>
</tr>
<tr>
<td><strong>Obesity risk:</strong> maternal-reported TV viewing time (&gt;10 hours per week classified as high TV viewing)</td>
<td>**T-tests revealed that infants of mothers with elevated EPDS scores gained significantly more weight than infants of mothers without depressive</td>
</tr>
<tr>
<td><strong>Child activity level:</strong></td>
<td></td>
</tr>
<tr>
<td>Age Group</td>
<td>Percentage</td>
</tr>
<tr>
<td>--------------------</td>
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</tr>
<tr>
<td>18-24 years</td>
<td>17.6%</td>
</tr>
<tr>
<td>25-34 years</td>
<td>64.5%</td>
</tr>
<tr>
<td>&gt; 34 years</td>
<td>17.8%</td>
</tr>
</tbody>
</table>

**Mean child age:** not reported.

Approximately 2 months at study entry.

**Maternal BMI ranges (% by categories):**
- 9.6% underweight
- 45.5% healthy weight
- 15.6% overweight
- 29.2% obese

**Mean child BMI:** not reported.

**Study setting:** mail-out questionnaires completed at home.

**Main outcome measure:** Infant feeding practices and infant weight gain at follow-up.

**Cut-off score:** ≥ 10 used to indicate probable depression.

**Prevalence:** 24.1% scoring above the cut-off.

**Covariates included were:**
- maternal race/ethnicity (Black, White, or Hispanic)
- age at childbirth
- education
- household income
- pre-pregnancy BMI
- smoking status
- child sex.

---

**Gross et al. 2013**

Bronx, New York City, USA

- **n = 401 mother-child dyads**
- % 54.6 male

**Design:** Cross-sectional

**Follow-up:** N/A

**Measurement points:**

To explore the relationship between maternal practices and weight gain at 6 months of age.

**Measure:** Patient Health Questionnaire

Children of mothers reporting moderate-severe depressive symptoms were...
**children**

| **Mean maternal age:** | 32.8 (SD = 6.1) |
| **Mean child age:** | not reported, approximately 5 years |

**Maternal BMI range (%) by categories:**
- 0.5% underweight
- 29.9% normal weight
- 32.3% overweight
- 37.2 obese

**Mean child BMI:** Not reported; 14.2% overweight, 22.9% obese

**Ethnicity:**
- 49.9% Hispanic
- 34.4% African-American
- 4.2% Asian
- 1% other

**Attrition:** N/A

| **Study setting:** Telephone interviews |
| **Main outcome measure:** Child weight, and obesity promoting practices |
| **Other obesity risk outcomes:** Outdoor play time using the Outdoor Play Time Recall Questions Scale (Burdette, Whitaker, & Daniels, 2004), and TV viewing time, assessed via maternal report. |

**depressive symptoms to child weight and obesity promoting behaviours (including feeding, sedentary and physical activity, and sleep time) in 5 year olds from low income ethnic backgrounds [PHQ-9] (Kroenke et al., 2001) to screen for depressive symptoms experienced over the previous 2 weeks**

**Cut-off scores:** Total scores were divided into categories of severity:
- Mild = 5-9
- Moderate to severe = 10-27

**Prevalence:** 23.4% had depressive symptoms present; 15.7% of these cases were mild, 7.7% were moderate-severe

**significantly more likely to be overweight or obese, compared to mothers reporting no symptoms (OR = 2.62, 95% SI = 1.02-6.70)**

**in both adjusted and unadjusted models. These children also had significantly less outdoor playtime. TV viewing time was not associated with maternal depressive symptoms. Mothers with mild depressive symptoms also had greater odds of having overweight and obese children than mothers reporting no symptoms (OR = 1.43, 95% CI = 0.75 – 2.72), however this association was non-significant in both adjusted and non-adjusted models.**

**Covariates included were:** child sex, parity, insurance status (of child), maternal age, education, ethnicity,
Grote et al. 2010
Cross-national: Belgium, Germany, Italy, Poland, Spain

- n = 929 mother-child dyads
- 43% male children
- Maternal age range at 24 month follow-up (in %; mean not reported):
  - < 28 years: 27.3%
  - 28 < 33: 39.1%
  - 22-44: 33.6%
- Mean child age (at 24 month follow-up): 24.2 months (SD = 0.6)
- Maternal BMI ranges (% by categories):
  - < 20 = 18.3%
  - 20-25 = 54%
  - 25-30 = 20.5
  - > 30 = 7.2
- Mean child weight (at 24 month follow-up): 12.4 kg (SD = 1.4)
- Ethnicity: not

Design: Prospective longitudinal randomised controlled-trial
Follow-up: 2 years
Measurement points:
- child age 12 and 24 months (child weight outcomes)
- Study setting: multicentre randomised multicentre study across different countries; all measurements recorded at study sites

Main outcome measure:
- child BMI z-scores

To test the hypothesis that maternal postnatal depression is a risk factor for child underweight or overweight at 2 years of age

Measure: 10-item EPDS (Cox et al., 1987)
Measurement points: 2, 3, 6 months after child birth
Cut-off score: ≥ 13 to indicate risk for depression (based on validation in previous literature)
Prevalence: 11%

VFRUHG•RQDW least one study time point; 1.7% (n = 18) had EPDS scores ≥ 13 at all study time points (2, 3 & 6 months); prevalence varied by country: 6-8% in Germany and Spain, 13-16% in Belgium, Poland and Italy.

Results are independent of covariates: maternal age, BMI, marital status, maternal smoking, child marital status, employment status

At 24-month follow-up, child WFL-z and BMI-z did not differ between children of mothers with elevated depressive scores and those with normal range scores. There was a significant positive linear relationship between maternal elevated EPDS scores and child weight in kilograms, however only in mothers who had elevated depressive symptoms at study entry, but not at 12-month measurement. There was no difference between high and low depressive scores groups (categorised by percentiles) with regard to child weight outcomes.
reported
Attrition: 57.4% at 2
year follow-up; only
participants with an
EDPS score
obtained at any time
point after birth
were included for
analysis

Guxens et al. 2013
Rotterdam,
Netherlands

$n = 5283$ mother-
child dyads
% male children not
reported

Mean maternal age
(at baseline - based
on BMI categories):
Underweight – 30.6
($SD = 4.3$)
Normal weight -
30.8 ($SD = 4.7$)
Overweight – 30.1
($SD = 5.3$)
Obese – 28.5 ($SD =
5.8$)

Median child age at
follow-up: 3.8 years
(mean not provided)

Mean maternal BMI: 85

Design: Prospective
longitudinal
Follow up: 4 years
Measurement points:
baseline measurement
taken during pregnancy
at approximately 20
weeks gestation,
subsequent follow-up at
3 months, 6 months, 1
year, 1.5 years, 2 years,
3 years and 4 years post-
partum
Study setting:
community health
centres and pen and
paper surveys mailed to
home
Main outcome measure:
To assess the
influence of
maternal
psychological
distress during
pregnancy on child
growth (weight,
height and BMI)
during the
preschool years

Measure: Dutch
version of the 53-
item Brief Symptom
Inventory [BSI] (de
Beurs, 2004).
Includes the Global
Severity Index
(severity of current
psychological
symptoms), and
Depression, Anxiety
and Hostility
subscales.
Measurement
points: antenatal
only – at
approximately 20
weeks gestation
Cut-off score:

birth order, child baseline
anthropometric data,
breastfeeding, caesarean
section, stress during
pregnancy and unwanted
pregnancy

In the unadjusted models:
maternal depression,
anxiety, hostility, and
overall psych symptoms
were positively related to
child BMI at 3 and 6
months of age
Adjusted models
(controlling for maternal
education, ethnicity, age,
smoking during pregnancy,
parity, marital status, and
maternal and paternal
BMI): relationships
between maternal
psychological variables and
child BMI became non-
significant.

Logistic regression
Mean child BMI: not provided. At 4 year follow-up, 2.1% were underweight, 82.9% were normal weight, 12.9% overweight, and 2.1% obese.

Ethnicity: predominantly Dutch.

Attrition: 42.1% at 4 years; non-completers had significantly lower socio-economic status; multiple imputation used to replace missing data.

Prevalence: 9.3% for Global Severity Index; 9.1% for Depression; 10.4% for Anxiety; 18.9% for Hostility; and 12.4% for family stress.

Analysis:
Maternal overall psychopathology, depression, anxiety and hostility scores were all significant predictors of child overweight and obesity at age 4, however these associations became non-significant after adjusting for maternal ethnicity.

Children of mothers who exceeded the clinical cut-off for depression were significantly more likely to be overweight or obese at age 4 compared to children of mothers without scores in the clinical range, however this association became attenuated and no longer significant in the fully adjusted models.

Lumeng et al., 2006
USA

n = 1016 mother-child dyads
50% male children
Mean maternal age:

Design: Cross-sequential (N.B. for the purpose of this review, only cross-sectional)

To investigate the relationship between television exposure and

Measure: CED-S (Radloff, 1977) to measure depression symptoms

Bivariate analyses at 36 months: ≥ 2hrs child TV viewing per day was significantly associated...
<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Country</th>
<th>Sample Size</th>
<th>Gender</th>
<th>Mean Maternal Age</th>
<th>Design</th>
<th>Follow-up</th>
<th>Measurement Points</th>
<th>Main Outcome Measure</th>
<th>Other Measures of Obesity Risk</th>
<th>Cut-off Score</th>
<th>Prevalence</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>McLearn et al. 2006</td>
<td>USA</td>
<td>3412</td>
<td>N/A</td>
<td>N/A</td>
<td>2-4 months, 20-30 months</td>
<td>Prospective</td>
<td>28 months</td>
<td>T1 child age 2-4 months, T2 child age 30-33 months</td>
<td>Overweight status at 36 months (defined as a BMI greater than or equal to the 95th percentile for age and sex, based on National Centre for Health Statistics norms)</td>
<td>Measured child TV exposure (maternal report questionnaire)</td>
<td>Not reported</td>
<td>Not reported</td>
<td>Maternal depressive symptoms did not significantly predict child TV viewing time at 36 months, nor did the other covariates (including child age and gender). TV viewing ≥ 2 hours per day was the only significant predictor of child overweight.</td>
</tr>
</tbody>
</table>
Mean child age: not reported; infants aged 2-4 months at T1 and 30-33 months at T2

Maternal BMI ranges (% by categories): 45.5% normal weight, 15.6% overweight, 29.2% obese

Mean child weight gain from birth to six months:
Infants of mothers with depressive symptoms: $M = 9.93$ pounds (SD = 2.23);
Infants of mothers without depressive symptoms: $M = 10.15$ (SD = 2.32)
and for No PND group: $M = 9.85$ (SD = 2.32)

Ethnicity: 22.6% black, 77.4% ‘not

Study setting: Mail-out questionnaires/telephone interviews completed from participants’ homes

Main outcome measure: parenting practices (including child TV viewing time); measured via maternal report items were deleted; included 9 items of the 10 item version

Measurement points: Completed at T1 and T2

Cut-off score: ≥ 11 used to indicate the presence of maternal depressive symptoms

Prevalence: 16.1% of mothers reported depressive symptoms at 2-4 months 15.5% reported depressive symptoms at 30-33 months

Significant in the adjusted models (OR = 0.93, CI: 0.76-1.14) – 65.81% of mothers with DS at 2-4 months reported their child watched 2+ hours per day

Children of mothers with depressive symptoms at 30-33 months were significantly more likely to watch 2+ hours of TV/videos daily in both unadjusted (OR: 0.66, CI: 0.54-0.80) and adjusted models (OR: 0.76, CI: 0.62 – 0.94). – 66.09% of mothers with DS at 30-33 months reported their child watched 2+ hours per day

No evidence for the cumulative effect of chronic depression (over two time points) on any parenting practices.

Covariates included were: maternal ethnicity, maternal age, maternal education, marital status, maternal
<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Sample Size</th>
<th>Gender</th>
<th>Age Range</th>
<th>BMI</th>
<th>Ethnicity</th>
<th>Attrition</th>
<th>Design</th>
<th>Measurement Points</th>
<th>Study Setting</th>
<th>Main Outcome Measure</th>
<th>Other Measures of Obesity Risk</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mistry et al., 2007</td>
<td>USA</td>
<td>n = 2707</td>
<td></td>
<td>30-33 months</td>
<td></td>
<td></td>
<td>27.6%</td>
<td></td>
<td></td>
<td>across nine quasi-experimental sites</td>
<td>Child behavioural and social outcomes (not relevant to the present review)</td>
<td>high child TV viewing time (used as a predictor of the main outcomes);</td>
<td>To analyse relationships between children’s early, concurrent and sustained television exposure and behavioural and social skills outcomes at 5.5 years of age</td>
</tr>
</tbody>
</table>
measured via maternal report and classified as >2 hours per day (including videos); analysed as early exposure (only baseline), concurrent exposure (only follow-up), or sustained exposure (baseline and follow-up)

<table>
<thead>
<tr>
<th>Morrissey 2013</th>
<th>n = 10,650 (pooled over 4 time-points; 10,700 at T1, 7,400 at T2, 6,000 at T3, 4,750 at T4)</th>
<th>51.09% male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean maternal age: not reported</td>
<td>Mean child age: 10.52 months (at baseline), 24.49 months at 2 years, 52.95 months at 3 years, 65.11 at 4 years</td>
<td>Design: Prospective longitudinal Follow-up: approximately 3 years Measurement points: T1 child age 9 months, T2 child age 2 years, T3 child age 3 years, T4 child age 4 years Study setting: Not reported Main outcome measure: child average daily TV viewing time (maternal report)</td>
</tr>
</tbody>
</table>

To explore the impact of maternal depressive symptoms on weight-related parenting practices from infancy through to preschool age

Measure: 12-item CES-D (Radloff, 1977); used at T1, 3 & 4; Composite International Diagnostic Interview-Short Form [CIDI-SF] (Kessler et al., 2003) used at T2. Measurement points: child age 9 months, 2, 3 and 4 years. Scores across the 4 time points exposure held the significant difference. Models were adjusted for mothers age at child’s birth, ethnicity, marital status, employment, and education, child’s sex, parity, household income, child’s health status, maternal depressive symptoms, health service usage, and parental involvement in child’s activities

Children of mothers with moderate-severe depressive symptoms watched 10.26 minutes of TV more on average daily ($p < .001$), and the duration (i.e. present at more than one time-point) of maternal depressive symptoms was positively associated with child TV viewing time ($p < .001$). Sensitivity analyses to exclude wave 2 data (where CIDI-SF was used instead...
Mean maternal BMI: not reported
Mean child BMI: not reported

Ethnicity: 54.7% Caucasian, 16.2% African-American, 17.8% Hispanic, 19.5% other

Attrition: 56%
however data was pooled, utilising available data across all time points

were pooled and analysed as a single variable of maternal depressive symptoms. Duration of symptoms was summed across the study waves to provide an average for use in the analyses, e.g. elevated scores at two different time-points was classified as “2 periods” of depressive symptoms.

Cut-off scores: ≥ 10 used for the CES-D to define elevated depressive symptoms; for the CIDI-SF an affirmative answer to one of three stem questions led to categorisation of "moderate to

of CED-S) found no bias between different measurement tools.

Analyses were adjusted for child sex, age, birth weight, multiple birth, race/ethnicity, insurance coverage, maternal employment, education, marital status, pre-pregnancy weight, and household income and geographic region.
severe depressive symptoms
Prevalence: 18-20% scoring above cut-offs at each of the four time points

Phelan et al. 2011
Rhode Island, USA

n = 363 mother child dyads
51% male children

Mean maternal age (by BMI category)
Normal weight: 28.2 years (SD = 5.5); Overweight/obese: 28.8 years (SD = 5.1)

Mean child age (at follow-up): 6 months

Mean maternal BMI (pre-pregnancy):
Overweight/obese mothers - 30.5 (SD = 5.3); normal weight mothers - 22.3 (SD = 1.8); at study entry – 46% overweight or obese;

Design: Prospective longitudinal
Follow up: approximately 1 year (6 months postpartum)
Measurement points:
Baseline taken at 10-16 weeks gestation; 30 week gestation follow-up, and 6 month postpartum
Study setting:
Participants recruited from obstetric practices into clinical trial of lifestyle intervention to reduce excessive gestational weight gain in women; data recorded at obstetric practices

Main outcome measure:
Child weight-for-age z-

To examine the impact of gestational weight gain, maternal eating and exercise behaviours, and psychosocial factors on child weight status at 6 months post-partum

Measure: EPDS (Cox et al., 1987) to measure depressive symptoms
Measurement points: 10-16 week gestation and 30 week gestation
Cut-off scores: not reported
Prevalence: not reported

Maternal depressive did not predict child weight outcomes (in either normal weight or overweight/obese mothers) in both unadjusted and adjusted models
Analyses were adjusted for treatment group, infant sex, recruitment clinic, weeks of gestation at delivery and breast-feeding. N.B. analyses were run separately for normal weight and overweight/obese mothers as this was found to impact on child weight outcomes
54% normal BMI

Mean child weight for age z-score (at 6 months): children of overweight/obese mothers: \( WFA-z = 0.38 \) (SD = 1.1) & 17.6% > 90th percentile; children of normal weight mothers: \( WFA-z = 0.34 \) (SD = 1.0), and 36.8% >90th percentile

Ethnicity: 62.7% of mothers who were overweight/obese were non-Hispanic white; 71.5% of normal weight mothers were non-Hispanic white. The ethnicity of the remainder of participants was not reported

Attrition: 31%

<table>
<thead>
<tr>
<th>Rodgers et al.</th>
<th>Design: Prospective</th>
<th>To test a model in</th>
<th>Measure: Weight</th>
<th>Bivariate correlations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>( n = 220 ) mother child</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Location</td>
<td>Sample Size</td>
<td>Sex Distribution</td>
<td>Mean Maternal Age</td>
</tr>
<tr>
<td>------------</td>
<td>-----------</td>
<td>-------------</td>
<td>------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>2013</td>
<td>Melbourne, Australia</td>
<td>dyads 47% male children</td>
<td>35 (SD = 0.46)</td>
<td>2.03 (SD = 0.37)</td>
</tr>
<tr>
<td>2013</td>
<td>Pelotas, Brazil</td>
<td>n = 3748 mother child dyads</td>
<td>52% male children</td>
<td>not reported; by range: 18.7% &lt; 20 years; 67.6% 20-34</td>
</tr>
</tbody>
</table>
years; 13.7% > 34

Mean child age: not reported

Mean maternal BMI - by category: 4.7%

≤ 18, 61.2% 18.5-24.9; 23.2% 25-29.9; 11% ≥30

Mean child BMI: not reported; 1.7% underweight, 12.2% overweight

Ethnicity: 73% Caucasian, 27% African-American/other

Attrition: 4.3%, 5.7%, 6.5%, and 8.0% at 3, 12, 24 and 48 month follow-up visits, respectively

Participants recruited from maternity hospitals; data collected by researchers at home visits

Main outcome measure: child weight for age z-scores (WFZ-A; scores ≥ 2 SD defined as overweight) at age 4

Child anthropometry at age 4 administered via interview rather than traditional pen & paper format, and was validated for use in this cohort

Participants categorised as: never depressed (EPDS <13 at all 3 follow-up visits), depressed in 1 or 2 follow-up visits, and chronically depressed (EPDS ≥13 at each follow-up visit).

Prevalence: 25.4% were depressed at 1 or 2 visits, and 4.7% were depressed at all three measurements

Analysis of mothers who had elevated EPDS scores at all three visits (chronic depression) found that odds ratios for child overweight at 4 years were 1.3 times higher than in children of mothers with scores <5 at all three measurements. Child underweight, stunting and wasting risks were also 3, 2 and 2 times higher, respectively, at age 4. When analysing the impact of maternal chronic depression on child WFA-z

stunting (p = 0.02) at 4 years of age, in unadjusted analyses. After adjusting for covariates (maternal age at delivery, ethnicity, family income, education, marital status, smoking, pre-pregnancy BMI, health care use), maternal depressive symptoms did not predict child weight outcomes at age 4.
To evaluate whether maternal depressive symptoms are associated with overweight in young children, aged between 6 and 26 months. To evaluate whether maternal depressive symptoms are associated with overweight in young children, aged between 6 and 26 months.

Measure: CES-D (Radloff, 1977) to measure depressive symptoms

Cut-off score: ≥16
Prevalence: 55.3% scored ≥16

Child overweight (WFL ≥ 85th percentile) was significantly more common in children of mothers with elevated depressive symptoms (i.e. CED-S score ≥ 16) than those of mothers without (39.9% vs. 28.5%, p = 0.004). Child overweight at the 95th WFL percentile was also significantly more prevalent in children of mothers with elevated depressive symptoms compared to children of mothers without (20.9% vs. 10.3%, p = 0.0005).

Having a mother with elevated depressive scores was associated with an almost two-fold risk of being overweight at the 85th percentile WHZ (Adjusted OR = 1.7; 95% CI: 1.3-2.2).
CI: 1.4, 2.2) and more than double the risk of child overweight at the 95th percentile (Adjusted OR = 2.3; 95% CI: 1.6, 3.3). Children aged 6-12 months were significantly more likely have WHZ >85th and 95th percentiles than children aged 12>18 months ($p < .05$). All analyses were adjusted for: child sex and age, birth weight, sanitation scale, SES conditions scale, breastfeeding duration, number of children in the household.

### Study Details

**Thompson & Bentley, 2012**
North Carolina, US

- **$n = 217$ mother-child dyads**
- 46.5% male children
- **Mean maternal age:** 22.7 (SD = 3.8)
- **Mean child age (at study entry):** 3.24 months
- **Mean maternal BMI:** not reported;

**Design:** Prospective longitudinal

**Follow-up:** 9 months

**Measurement points:** baseline (infants age 3 months), follow-up at 6, 9 and 12 months of age

**Study setting:** researchers visited participant homes

**Prevalence:** 29.11%

**Measure:** CES-D (Radloff, 1977)

**Cut-off score:** ≥16

**Measurement points:** at all study time points (see across)

In the logistic regression model, maternal depression was associated with higher odds of inappropriate feeding at all measurement points, however this relationship became non-significant in the fully adjusted models (controlling for maternal
44.2% had BMI ≥ 30

*Mean child BMI:* not reported

**Ethnicity:** All African-American

**Attrition:** 36%

<table>
<thead>
<tr>
<th>Main outcome measure:</th>
<th>Infant weight for length (WFL) percentile (age and sex specific based on the CDC 2000 growth reference charts); high WFL was defined as ≥ 90th percentile (based on previous studies' cut-offs)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Other measures of obesity risk:</strong> Age</td>
<td></td>
</tr>
<tr>
<td>Inappropriate child feeding practices: used to measure risk of child obesity and overweight. Maternal report of child food intake including liquids other than breast milk/formula or solids at 3 months; cow or soy milk (instead of breast milk/formula), meat, eggs, cheese, junk, fast foods and/or sweets at ages 6 and 9 months, and flavoured milks,</td>
<td>feeding to determine risk factors for child obesity</td>
</tr>
<tr>
<td>age, BMI, marital status, work status, education, child age and sex, and repeated measures across subjects, and breastfeeding). Inappropriate feeding was related to higher odds of high WFL percentiles across infancy (in adjusted models) compared to infants fed according to recommendations.</td>
<td></td>
</tr>
</tbody>
</table>
junk, fast foods and or sweets at ages 12 and 18 months. This was evaluated as a combined variable of all feeding measurements (i.e. between 3 and 18 months of age).

<table>
<thead>
<tr>
<th>Wojcicki et al. 2011</th>
<th>n = 201 mother-child dyads</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Francisco, USA (Latino sample)</td>
<td>51.8% male children</td>
</tr>
<tr>
<td>Mean maternal age: not reported</td>
<td>Mean child age: not reported</td>
</tr>
<tr>
<td>Mean maternal BMI (4-6 weeks postnatal): 28.3 (SD = 6.3); 67.9% overweight, 33.5% obese</td>
<td>Mean child BMI: not reported. At birth: 7.4% overweight, 2.1% obese; at 6 months: 26.1% overweight, 11.1% obese; at 12 months:</td>
</tr>
<tr>
<td><strong>Design:</strong> Prospective longitudinal</td>
<td><strong>To evaluate the relationship between prenatal and postnatal maternal depressive symptoms experienced in pregnancy and infant growth from birth to 2 years of age, in children of Latino ethnicity</strong></td>
</tr>
<tr>
<td><strong>Follow-up:</strong> 2 years</td>
<td><strong>Measure:</strong> EPDS (Cox et al., 1987), CES-D (Radloff, 1977) and Mini International Neuropsychiatric Interview [MINI] (Sheehan et al., 1998) to assess whether major depressive episodes or dysthymia were currently present</td>
</tr>
<tr>
<td><strong>Measurement points:</strong> 6, 12 and 24 months</td>
<td><strong>Cut-off scores:</strong> score of ≥10 on the EPDS and ≥16 on the CES-D</td>
</tr>
<tr>
<td><strong>Study setting:</strong> Prenatal clinics</td>
<td><strong>Measurement points:</strong> baseline during pregnancy</td>
</tr>
</tbody>
</table>
| **Main outcome measure:** weight for length z-scores at 6, 12 and 24 months (based on CDC growth charts). Secondary outcomes included risk for overweight and obesity (≥85th percentile and ≥95th percentile respectively) | Exposure to chronic depression was associated with decreased risk for child overweight in unadjusted (OR 0.29, 95% CI: 0.09–0.98) and adjusted models (OR 0.28, 95% CI: 0.03–0.92) in comparison with children not exposed to maternal depressive symptoms or those exposed episodically. There were no significant relationships between maternal clinical depression and child weight outcomes. Covariates included were: infant birth weight z-score or birth weight-for-length z-score, breast-feeding at 6
| Ethnicity: 61.2% Mexican; remainder Central American origin (El Salvadorian, Guatemalan, Honduran) | Chronic depression was defined as having an elevated score at both time points (including a possible diagnosis of clinical depression, based on MINI scores at either measurement), and episodic depression was defined as having elevated depressive symptoms at one time point (including a possible diagnosis of clinical depression, as based on MINI scores at either measurement). |
| 27.6% overweight, 12.6% obese; and at 2 years: 40.5% overweight, 20.2% OB | follow-up (via telephone) at 4-6 weeks postpartum |
| Attrition: 10% | months, maternal postnatal (12–24 months) BMI, maternal ethnicity (Central American versus Mexican), maternal age and gestational age. |
Prevalence:
Prenatally, 28.9% of participants evidenced depressive symptoms. At 4–6 weeks post-partum this number declined to 15.7%. Depressive symptoms were evident in 22.5% of women at either the prenatal or 4–6 week time point, and 11.0% had chronic depressive symptoms (i.e. symptoms at both prenatal and 4–6 week measurements). Clinical depression was prevalent in 4.0% (8/201) had prenatally and 4.3% at 4–6 weeks but, only one of these
eight participants had clinical depression at both time-points.
Discussion

This systematic review included 20 papers that assessed the relationships between indices of maternal psychopathology (predominantly depressive symptomology), and risks for overweight/obesity in pre-school aged children, including weight outcomes, nutrition/diet variables, physical activity, and sedentary behaviours.

Summary of Findings

There was a positive relationship between maternal depressive symptoms and risks for pre-schooler overweight and obesity in 15 out of the 19 (79%) studies that measured maternal depressive symptoms (Burdette et al., 2003; Ertel et al., 2012; Ertel et al., 2010; Fernald et al., 2008; Gaffney, Kitsantas, Brito, & Swamidoss, 2012; Gross et al., 2013; Grote et al., 2010; Guxens et al., 2013; Lumeng et al., 2006; McLearn et al., 2006a; Mistry et al., 2007; Morrissey, 2013; Santos et al., 2010b; Surkan et al., 2008; Thompson & Bentley, 2012). Five of these studies (Burdette et al., 2003; Gross et al., 2013; Lumeng et al., 2006; Mistry et al., 2007; Surkan et al., 2008) were cross-sectional designs, preventing conclusions being drawn about the direction of causality. Maternal anxiety, hostility and general psychopathology were significant predictors of child overweight/obese status (Guxens et al., 2013), and maternal body dissatisfaction was found to indirectly predict child BMI-z change in a positive direction, via maternal dietary restraint (Rodgers et al., 2013). The majority of studies measured maternal depressive symptoms across several time points, and importantly, the time at which this outcome was measured (i.e., antenatal, postnatal, isolated episode or chronic) appeared to impact on its relationship to pre-schooler overweight/obesity. However the underlying mechanism of influence is unclear, as
results varied vastly between studies. It appears that sampling a range of different

time-points, beginning ante-natally, and continuing post-natally, into the later pre-
school years, is ideal to obtain a complete picture of this relationship over time.

Whether pre-schooler overweight/obesity was analysed dichotomously or
continuously also led to differences in study findings, with the latter being more likely
to show associations with maternal psychopathology. It may be the case that sample
sizes of overweight and obese children were not large enough within the overall study
samples, thus reducing power to detect a significant relationship when analysing
overweight and obesity dichotomously.

In studies examining pre-schooler overweight/obesity risks other than weight
outcomes, significant associations with maternal depressive symptoms were generally
consistent. All studies examining high levels of pre-schooler TV viewing reported it
had a significant positive relationship to maternal depressive symptoms. The single
study examining low levels of pre-schooler physical activity also found this had a
significant relationship to maternal depressive symptoms.

Although several studies have confirmed positive relationships between
maternal psychopathology and obesity risk in school aged-children and adolescents
(Lane, Bluestone, & Burke, 2013; Topham et al., 2010b; Wang et al., 2013b), this
review suggests these associations are present as early as the preschool years. The
review findings are consistent with Harrison et al. (2011) developmental ecological
model of child obesity, whereby ‘clan’ or family characteristics, such as maternal
mental health, nutritional knowledge, encouragement of physical activity, and feeding
practices are all proposed to influence child obesity risk factors, such as BMI,
physical activity and eating/diet-related variables. Previous research suggests that
Maternal depressive symptoms are associated with a myriad of negative parenting practices: less healthy feeding behaviours (Paulson, Dauber, & Leiferman, 2006b), poorer health care (Kavanaugh et al., 2006) and safety practices (McLearn, Minkovitz, Strobino, Marks, & Hou, 2006b), less regulation of TV viewing time (McLearn et al., 2006b), and more disengaged, uninvolved (Kavanaugh et al., 2006; Lovejoy, Graczyk, O’Hare, & Neuman, 2000; McLearn et al., 2006b) and lax (Errazuriz-Arrellano, Harvey, & Thakar, 2012) parenting practices. (Topham et al., 2010b) found that permissive parenting, which was related to obesity in first-graders, was significantly more common in mothers with elevated depressive symptoms. Taken together, the literature tends to suggest that mothers who are battling against depressive symptoms may be limited in their resources to provide optimal care to their child, and thus subsequently lead to a lesser involvement in the offspring’s life, which may explain the increased risk of pre-schooler overweight/obesity noted in the present review. However, it is likely that maternal depressive symptoms operate in conjunction with several other variables to impact on this risk.

Maternal factors independent of mental health are also suggested by Harrison et al.’s (2011) model to influence child obesity risks. These include ethnicity, socioeconomic status, marital interactions, and parental encouragement. In the present review, all but one study (Rodgers et al., 2013) adjusted for known covariates to some extent, and in five of the 20 studies (25%), associations between maternal psychopathology and child weight outcomes became non-significant after covariates were factored into the analysis. Ethnicity, maternal BMI, age, education, marital status and smoking status, socio-economic status/family income and child sex were commonly reported covariates, although many studies controlled for these prior to analysing their relationship to maternal psychopathology indices and pre-schooler
obesity risk outcomes, thus the influence of these covariates over this relationship is unclear. Two studies reported maternal ethnicity as having a strong impact on their analyses (Ertel et al., 2012; Guxens et al., 2013). In the Western world, ethnicity has been associated repeatedly with child overweight and obesity (Barroso, Roncancio, Hinojosa, & Reifsnider, 2012; Caprio et al., 2008; O’Dea, 2008; Ogden et al., 2012; Schmeer, 2012; Taveras et al., 2010). Low socio-economic status is also thought to mediate the relations between ethnicity and child overweight/obesity (Caprio et al., 2008; Wang & Lobstein, 2006). While several studies in the present review controlled for family income/socio-economic status (Ertel et al., 2010; Fernald et al., 2008; Gaffney et al., 2014; Lumeng et al., 2006; Mistry et al., 2007; Morrissey, 2013; Santos et al., 2010b; Surkan et al., 2008), the relationship between these variables and ethnicity was not analysed within these studies. It should be noted that all but two of the studies that did not include ethnicity as a covariate comprised samples from single cities; two from the United States (Phelan et al., 2011; Thompson & Bentley, 2012) one from Mexico (Fernald et al., 2008), and one from Brazil (Surkan et al., 2008). These studies also failed to report on ethnicity, therefore it cannot be determined whether these samples contained homogenous or heterogeneous ethnic samples, and thus whether ethnicity may have influence their results. The remaining two studies drew on nationally representative samples (Bronte-Tinkew et al., 2007), and cross-national samples (Grote et al., 2010), the former study reporting their sample over-represented Asian and Northern American individuals but failing to report ethnic distributions within their sample.

Maternal education has also been strongly linked to child overweight and obesity risks in the literature (Biehl et al., 2013; Reilly et al., 2005a; Shrewsbury & Wardle, 2008; von Kries, Toschke, Koletzko, & Slikker, 2002; Weng, Redsell, Swift,
Yang, & Glazebrook, 2012), as has maternal overweight/obesity (Lean, 2010; Whitaker et al., 2010), marital status (Bzostek & Beck, 2011; Gibson et al., 2007b; Rooney, Mathiason, & Schauburger, 2011; Schmeer, 2012; Weng et al., 2012), smoking status (Al Mamun et al., 2006; von Kries et al., 2002; Wang et al., 2013b), and child sex (Biehl et al., 2013; Bosmans, Goossens, & Braet, 2009; O'Dea, 2008). Whilst the majority of studies included these covariates in their analyses, it would be ideal for future studies to ensure all of these known covariates are controlled for, and to analyse their relationship to pre-schooler obesity risks and maternal psychopathology indices separately, to determine their true association.

It is important to note that some studies (Santos et al., 2010b; Wojcicki et al., 2011) found links between maternal depressive symptoms and child underweight, or lower weight than children of mothers without depressive symptoms (Duarte et al., 2012). Existing literature supports this association, however, the relationship appears to exist mainly in developing countries, or socioeconomically deprived populations within developed countries (Anoop et al., 2004; Gress-Smith, Luecken, Lemery-Chalfant, & Howe, 2012; Nasreen, Kabir, Forsell, & Edhborg, 2013; Rahman, Lovel, Bunn, Iqbal, & Harrington, 2004; Surkan et al., 2007; Traviss, West, & House, 2012). Ramsay, Gisel, McCusker, Bellavance and Platt (2002) found no relationship between child underweight and maternal depressive symptoms in a sample of Canadian women of average socio-economic status, whilst Traviss et al. (2012) found Pakistani women with depressive symptoms who were living in areas of high social deprivation within the United Kingdom were more likely to have underweight children than Caucasian women with depressive symptoms with less social deprivation. These findings suggest that socioeconomic status and food security may play an important role in the association between maternal depressive symptoms and weight status.
Strengths of the Reviewed Studies

The studies included for review were generally characterised by strong methodology, including longitudinal designs, adequate follow-up periods and sample sizes, and multivariate statistical analysis controlling for known covariates. Pre-schooler weight outcomes were measured objectively in all studies, either by the researchers or obtained from clinical records, reducing risk of bias. The assessment of depression was consistent across the studies with all but two employing one of two self-report measures (see Table 1); the remaining two studies nonetheless employed other self-report tools that are psychometrically reliable and valid. One study cross-validated their assessment of depression via clinical interviews (Wojcicki et al., 2011). Across the studies, maternal depressive symptoms were measured at varying time-points in the child’s life, and in several studies, depressive symptoms were also measured at multiple time-points, e.g. antenatal and postnatal measurements, or several post-natal measurements. Previous research has shown that the presence of maternal depressive symptoms fluctuates largely from pregnancy throughout the preschool years (Woolhouse, Gartland, Mensah, & Brown, 2014). Findings differ within the existing literature, with some reporting the highest rates of depressive symptomology ante-natally (Josefsson, Berg, Nordin, & Sydsjö, 2001; Leigh & Milgrom, 2008; Leung & Kaplan, 2009), others within the first six months post-partum (Lee et al., 2007; Wang, Wu, Anderson, & Florence, 2011; Zelkowitz et al., 2008), and others reporting the lowest rates of symptomatology three months post-partum and the highest at child age four (Woolhouse et al., 2014). In the present review, results were mixed between studies measuring depressive symptoms at different time-points in the pre-schooler’s life. This highlights the importance of
screening for depressive symptoms several times throughout the preschool years to obtain an accurate picture of their relationship to pre-schooler obesity risks.

**Limitations of the Reviewed Studies**

Although child weight outcomes were measured in nearly all studies, only a handful of studies examined other risks for pre-schooler overweight/obesity, such as child TV viewing time, physical activity and amount of outdoor play (sedentary behaviour), while no studies examined child diet/nutrition variables. Given their previously reported links with child obesity (Anderson, 2006; Epstein, Paluch, Gordy, & Dorn, 2000; Robinson, 2001; Tremblay & Willms, 2003a; Trost et al., 2003), child nutrition/diet and activity levels are important factors to consider, either as contributors or covariates. Similarly, while maternal depressive symptoms were measured in nearly all studies, other indices of maternal psychopathology of interest were neglected. Maternal anxiety and body dissatisfaction were measured only in single studies, and maternal self-esteem was not measured by any studies. Evidence suggests that associations between maternal body dissatisfaction and child feeding practices are linked to child obesity (Duke et al., 2004; Hauff & DeMerath, 2012b). Furthermore, maternal body dissatisfaction has been linked to disturbances in child eating and low body dissatisfaction (Lowes & Tiggemann, 2003; Sands & Wardle, 2003), increasing the chance of binge and disordered eating (Stice et al., 2005), which are also risks for later overweight and obesity.

Whilst 12 of the 20 studies controlled for child sex, only one study (Duarte et al., 2012) analysed relationships between maternal psychopathology and pre-schooler overweight/obesity risk separately for male and female children. Consistent with previous literature (Hurley, Black, Papas, & Caufield, 2008b; Ystrom, Barker, &
Vollrath, 2012b), this study (Duarte et al., 2012) found differences in the relationship between maternal depressive symptoms and pre-schooler weight outcomes between child sexes. Therefore, it is important that future studies consider how maternal psychopathology may differentially affect male and female pre-schoolers’ risk for overweight and obesity.

Another limitation of the reviewed studies is that all but one study (Wojcicki et al., 2011) employed self-report measures of depressive symptoms, which are screening rather than diagnostic tools. Thus only the presence of depressive symptoms, rather than major depressive disorder, could be examined. The use of screening tools may have led to many cases of probable depression being missed within the study samples, as patients may appraise their own depressive symptoms less severely than clinicians’ objective ratings (Cusin, Yang, Yeung, & Fava, 2010; Leung & Kaplan, 2009). Additionally, several studies had only very small percentages (i.e., 6-10%) of mothers evidencing significant depressive symptomology, in contrast to epidemiological studies which have reported prevalence rates as high as 32.2% using the CES-D with a cut-off of ≥16 (Wang et al., 2011), and 31.4% using the EPDS with a cut-off of ≥13 (Woolhouse et al., 2014). It appears these studies within the present review (which used the same measures as the epidemiological studies) may have under-diagnosed maternal depressive symptoms. However, all but one (Grote et al., 2010) of the five studies (Ertel et al., 2012; Ertel et al., 2010; Guxens et al., 2013; Phelan et al., 2011) reporting low prevalence/failing to report the prevalence of depressive symptoms did not use nationally representative samples, whereas studies that did have nationally representative samples recorded prevalence rates consistent with epidemiological studies. This may suggest that the
samples of these studies had below average rates of mothers with depressive symptoms.

Furthermore, the studies by Grote et al. (2010) and Ertel et al. (2012) employed a cut-off score of ≥13 to detect depressive symptoms on the EPDS-10; however, the developers of this scale recommend a cut-off of 9/10 to reduce failure of detection to less than 10%, as a cut-off of 13 had a positive predictive value of only 73% in their validation study (Cox et al., 1987). It is possible that the cut-off score employed by Grote et al. (2010) and Ertel et al. (2012) was too conservative to detect the full range of depressive symptoms within their sample. The remaining studies reporting low prevalence of depressive symptoms utilised non-validated cut-off scores (Ertel et al., 2010; Guxens et al., 2013) or did not report whether cut-offs were used (Phelan et al., 2011).

Despite the limitation of a small number of studies recording low prevalence of maternal depressive symptoms, the self-report measures of depressive symptoms used were consistent across studies and are psychometrically reliable and valid. Given the costs and resources involved in using diagnostic tests for depression, it would be unlikely that many studies would employ such methods.

Attrition rates within the longitudinal studies were generally high; one study failed to report attrition rates (Rodgers et al., 2013). Studies with retention rates below 70% are considered flawed with regard to validity and reliability of their results (Rivet Amico, 2009). In our review, 58% of the studies failed to retain 70% or more of their participants to follow-up. Only two studies reported employing imputation methods to estimate missing data, the remainder used completer-only data or failed to comment on how missing data was handled. One study (Ertel et al., 2012) noted that
percentages of baseline depressive symptoms were higher in non-completers within their sample, highlighting the importance of considering the characteristics of participants with missing data, as it is likely that those more likely to drop out are those experiencing greater psychopathology. Lastly, participants of each study were predominantly White-Caucasian, limiting the generalizability of these results to other ethnic groups. Given that ethnicity was commonly noted as a significant covariate in the relationship between maternal psychopathology and pre-schooler overweight/obesity risk, and that previous literature has reported that child overweight and obesity is higher in certain ethnicities (Killion, Hughes, Wendt, Pease, & Nicklas, 2006; Ogden et al., 2012; Wang & Lobstein, 2006) it is encouraging that nine of the reviewed studies (Duarte et al., 2012; Ertel et al., 2012; Ertel et al., 2010; Guxens et al., 2013; Lumeng et al., 2006; McLearn et al., 2006a; Mistry et al., 2007; Rodgers et al., 2013; Santos et al., 2010b) controlled for this.

**Recommendations for Future Research**

Based on the findings of the review, several gaps have been identified for future studies to address when examining the relationship between maternal psychopathology and pre-schooler obesity risks. Researchers should recruit adequate samples of mothers with significant levels of depressive symptoms (~30%), as well as those without mental health concerns as control comparators. This will increase statistical power to determine a true association between maternal depressive symptoms and pre-schooler obesity risks. It is also important to employ well-known valid and reliable screening tools of depressive symptoms with validated cut-off scores, and to measure maternal depressive symptoms across several time-points (both antenatal and postnatal) to accurately determine the interaction between the timing of maternal depressive symptoms and pre-schooler obesity risk factors. Future
research should investigate relations between pre-schooler overweight/obesity risks and several indices of maternal psychopathology, such as maternal body dissatisfaction, anxiety symptoms, and self-esteem, as the findings of this review revealed that this knowledge base does not currently exist. They should also go beyond solely considering child weight as an outcome, and investigate other risks including quality and quantity of dietary intake, physical activity levels, and sedentary behaviours. Known confounders must be controlled, including socioeconomic status, maternal age, ethnicity, education, and marital status. Outcomes for male and female children should be analysed separately, to ensure conclusions made about maternal psychopathology and child obesity risks are valid for both sexes. Ideally, future studies should be longitudinal with adequately powered sample sizes to allow for multivariate statistical analyses, should aim to have low attrition rates (<30%), and should employ objectively measured pre-schooler obesity risk factors. Furthermore, as the present review was narrative, an empirical review including meta-analysis would be beneficial to clarify the strength of relationships between maternal psychopathology and pre-schooler obesity risks.

If these considerations can be made, future research will have the capacity to ascertain reliable, meaningful risk factors of pre-schooler overweight and obesity stemming from the mother’s mental health, and thus help to inform best practice treatment of existing pre-schooler overweight and obesity by elucidating the best targets for its prevention.
References


with prevention practices and parenting behaviors for preschool children.


Chapter Three

Methodology of the empirical studies

The Proposed Model and Studies

The pre-school years have been identified as the formative years for the development of lasting eating and physical activity patterns (Birch & Fisher, 1998b), and may be a critical period in which lifelong weight patterns are established (Clark et al., 2007). Thus, overweight and obesity status at this stage may set up the pre-schooler for persistent excess weight throughout childhood, adolescence, and even persevering into adulthood. Given the variety of physical and mental health consequences overweight and obesity has been linked to in both childhood (Steinbeck, 2010; Tsiros et al., 2009) and adulthood (Gortmaker et al., 1993; Sanderson et al., 2011), it is crucial that avenues of treatment, and ideally prevention during the formative years are identified to ensure healthy child development. The starting point for intervention and prevention initiatives is to ascertain contributing factors to overweight and obesity that are most proximal to the child. Based on Harrison et al.’s (Harrison et al., 2011) developmental ecological theory of child overweight/obesity described in the introductory chapters, the family, or “Clan” is the second influential layer over the core in the development of overweight/obesity, with genetics/biology being the core, and the child itself being the first layer.

In light of the evidence reviewed in chapter 1 that supports the association between child overweight/obesity risks, maternal psychopathology, including body dissatisfaction, and child feeding practices, a research model that incorporates all these factors and examines the interactions between them is warranted. Current
literature has generally failed to control for identified covariates of child overweight/obesity, including maternal BMI, education attainment and SES. Furthermore, many studies have failed to analyse maternal impacts by child gender, which may be important as some research has identified differential feeding practices between genders depending on type of maternal psychopathology (Haycraft & Blissett, 2008b; Hurley et al., 2008a; Ystrom et al., 2012a). More prospective designs are also needed to ascertain direction of causality.

In an attempt to address the limitations of the current literature outlined by this review, the following model, depicted in Figure 3.1, is proposed.

![Figure 3.1. Proposed model for evaluating associations between maternal psychopathology, child feeding practices, and preschool child BMI.]

This model integrates maternal psychopathology indices including depressive symptomology, to build on evidence from pre-existing literature, and anxiety, self-esteem and body dissatisfaction, which have been less commonly investigated as contributors to pre-schooler obesity risk. The influence of these factors on restrictive and pressure feeding practices will be considered, as well as taking into account known covariates (maternal BMI, marital status, family income). Finally, the impact of these interactions on pre-schooler weight outcomes (BMI-z score) will be examined.

The Empirical Studies
The first study, which was accepted for publication in *Early Child Development and Care* (Benton, Skouteris, & Hayden, 2015a) was a cross-sectional study that aimed to examine the relationships between the maternal psychopathology indices shown in the model (depressive and anxiety symptoms, self-esteem and body dissatisfaction), maternal child feeding practices (pressure and restriction) and pre-schoolers’ BMI-z scores. Baseline measurements (Time 1: T1) of the demographic and maternal variables outlined were taken at study entry, when the children were between two and four years old ($M = 2.9$, $SD = .75$). Using a hierarchical regression model, the first study examined the associations between maternal depressive and anxiety symptoms, self-esteem and body dissatisfaction, child feeding practices, and pre-schoolers’ BMI-z at T1. It was hypothesised that higher scores on maternal psychopathology measures would predict higher child BMI-z, and that this relationship would be mediated by the use of restriction and pressure feeding practices.

The aim of the second empirical study was to expand on study one by examining these relationships longitudinally. Demographic variables, baseline measures of maternal psychopathology indices, and child feeding practices were used as predictors of child BMI-z score change at follow-up, 24 months from baseline (Time 2: T2). A path analysis was employed to statistically test the proposed model (Figure 3.1). Specifically, it was hypothesised that that the demographic variables would predict baseline maternal psychopathology scores, which in turn would predict greater use of baseline restriction and feeding practices, and that these feeding practices would subsequently predict child BMI-z change scores in a positive direction.

**Research Aims**
The overarching aim of the empirical thesis was to identify maternal predictors of pre-schooler overweight and obesity. The specific aim was to assess whether indices of maternal psychopathology (depressive and anxiety symptomology, self-esteem, and body dissatisfaction) were associated with the use of restrictive and pressure feeding practices, and whether these feeding practices were associated with pre-schooler BMI-z scores.

**Procedure**

Participants volunteering to take part in the study were recruited between 2010-2012 from Victoria, Australia. Participants were recruited via advertisements placed in well-known parenting magazines (e.g., Nurture), posters displayed within metropolitan and rural kindergartens, pre-schools and childcare centres, and by word-of-mouth. The advertisement invited parents of two to four year-old children (pre-school aged) to participate in a study “looking at what factors may be associated with weight changes in pre-school children” (Appendix A).

Prospective participants expressed their interest to the project manager and were subsequently posted the plain language statement and consent forms (Appendix B), and then the cover letter and questionnaire packs (Appendix C), which were completed at home. Within these packs, participants were provided with the contact details for the researchers working on the project, an outline of what the questionnaires examined, and the estimated time frame the questionnaires would take to complete (50-70 minutes). Questionnaires were sent to participants’ homes at baseline (T1) and 24 months post baseline (T2). Participants were also provided with information regarding confidentiality of their data, informed consent for both themselves and their child, and the benefits and possible harms that may arise from their participation in the study. To uphold the confidentiality of participant data, each
participant was allocated a numeric ID number that was attached to each questionnaire, and participant data was recorded in an electronic database by corresponding ID number, rather than their names, to de-identify the data. Participants’ identifying details and corresponding ID numbers were contained in separate, secured documentation. Participants were entered into a draw to win one of 20 x $50 gift vouchers in exchange for their participation. The study was approved by the Deakin University Human Research Ethics Committee (Appendix D).

Participants

Study one. A total of 527 Australian mothers of pre-school aged children (2-4 years old) registered their participation in the present study. Of these, 298 (56.5%) returned questionnaires. A further eight cases were identified as multivariate outliers and removed from the dataset. Thus, a total of 290 participants were included in the final analyses. Participants were all English speaking; there were no other exclusion criteria.

Study two. Of the original sample used in Study One (N = 290), 80 participants did not return questionnaires at 24-month follow-up (27.6%), and a further 13 participants did not provide child BMI data (33% total missing data for the outcome variable). In addition to the eight multivariate outliers removed from the Study One dataset, a further 11 cases were identified as multivariate outliers and removed from the Study Two dataset, leaving 186 participants with complete data. Multiple imputation was then employed on the final sample to estimate missing data for the 93 missing cases, thus a total of 279 participants were included in the final analyses. As in Study One, participants were all English speaking and there were no other exclusion criteria.

Measures
Demographic Information. A range of demographic variables were collected using a questionnaire created for the purpose of the project. These included: maternal and child age, child gender, mothers’ location of birth, maternal education, marital status, employment status and annual family income. Maternal education level was indicated by self-report of one of the following options: still at secondary school, did not finish secondary school, Year 12 or equivalent, certificate level, Advanced Diploma/Diploma, Graduate Diploma/ Graduate Certificate, Bachelor Degree Certificate, Postgraduate Degree. Family income was specified in increments of $25,000, ranging from under $25,000, up to over $145,001. Mothers reported chose from one of the following categories to best indicate their marital status: married, divorced, de facto, separated, widowed, and never married. Current employment status was a dichotomous yes or no response. Mothers’ location of birth was specified as one of the following options: Australia, New Zealand, North-West Europe, North America, Southern & Eastern Europe, South America, North Africa & Middle East, Southern & Central Asia, Central, Western & Southern Africa.

Maternal and Child Anthropometry. Maternal self-reported weight and height data were utilized to calculate Body Mass Index (BMI) scores. Adult BMI is a weight for height index, that is calculated by dividing an individual’s weight (in kilograms) by their height squared (kg/m²) (World Health Organisation, 2015). Scores of $\geq 25$ are indicative of overweight, and $\geq 30$ are indicative of obesity. BMI scores are a useful broad measure of overweight and obesity as the categories are consistent across age (18-65) and sex, however they are do not measure body fat percentage (World Health Organisation, 2015). Nonetheless, BMI scores are widely used in the literature and thus provide a generalizable measure of weight status, they are time and cost-effective to measure and calculate, and scores tend to be correlated with an individual’s body
fat percentage in both adults (Shah & Braverman, 2012) and children (De Onis & Lobstein, 2010).

Child height in centimetres and weight in kilograms were reported by mothers, and these values were used to calculate children’s BMI and BMI z-scores at T1 and T2. BMI was calculated according to the WHO Child Growth Standards for pre-schoolers (DeOnis & Lobstein, 2010). These standards are the current international standard for the measurement of physiological growth in children less than five years of age, and were created using scientifically rigorous procedures in several ethnically diverse countries, in a sample of more than 8500 children (WHO Multicentre Growth Reference Study Group, 2009a). The weight categories by BMI-z scores can be seen below for boys (Table 3.1) and girls (Table 3.2) aged between 2-5 years. In empirical Study One, BMI-z scores were used as the outcome variable, and in empirical Study Two, BMI-z change scores between T1 and T2 were calculated and used as the outcome variable of the model. Change scores have shown to be reliable when used as dependent variables, without regression towards the mean (Allison, 1990).
Table 3.1

*WHO Child Growth Standards BMI-z score categories for boys aged between 2-5*

<table>
<thead>
<tr>
<th>Child Age</th>
<th>Median</th>
<th>1SD</th>
<th>2SD (obese)</th>
<th>3SD (obese)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 months</td>
<td>16.0</td>
<td>17.3</td>
<td>18.9</td>
<td>20.6</td>
</tr>
<tr>
<td>36 months</td>
<td>15.6</td>
<td>16.9</td>
<td>18.4</td>
<td>20.0</td>
</tr>
<tr>
<td>48 months</td>
<td>15.3</td>
<td>16.7</td>
<td>18.2</td>
<td>19.9</td>
</tr>
<tr>
<td>60 months</td>
<td>15.2</td>
<td>16.6</td>
<td>18.3</td>
<td>20.3</td>
</tr>
</tbody>
</table>

Table 3.2

*WHO Child Growth Standards BMI-z score categories for girls aged between 2-5*

<table>
<thead>
<tr>
<th>Child Age</th>
<th>Median</th>
<th>1SD</th>
<th>2SD (obese)</th>
<th>3SD (obese)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 months</td>
<td>15.7</td>
<td>17.1</td>
<td>18.7</td>
<td>20.6</td>
</tr>
<tr>
<td>36 months</td>
<td>15.4</td>
<td>16.8</td>
<td>18.4</td>
<td>20.3</td>
</tr>
<tr>
<td>48 months</td>
<td>15.3</td>
<td>16.8</td>
<td>18.5</td>
<td>20.6</td>
</tr>
<tr>
<td>60 months</td>
<td>15.3</td>
<td>16.9</td>
<td>18.8</td>
<td>21.1</td>
</tr>
</tbody>
</table>

With regard to the use of self-reported values, a literature review of the accuracy of self-reported weight and height data in adult women by Engstrom, Paterson, Doherty, Trabulsi, and Speer (2003) indicated that 21 out of 26 studies women overestimated their height, and all 34 studies measuring weight estimation found women underestimated their weight. The review reported that inaccuracies were generally small, however, recommended direct objective measurement of height and weight data where possible. In pre-school aged children, O'Connor and Gugenheim
(2011) reported that inaccuracies in parental reports of height and weight data were positively correlated with age, female sex, and child BMI-z scores. Boys’ height was marginally overestimated, whilst girls’ height underestimated and weight overestimated. However, the authors also noted there were no significant differences between BMI-z scores based on parental report and independently measured height and weight data. In the current sample, a subsample \( n = 65 \) participated in home visits, where researchers first asked mothers to report their own and their child’s height and weight, and then these data were collected objectively for both mothers and children using calibrated electronic scales to measure weight, and a stadiometer to measure height. Mothers and children were asked to remove shoes and any heavy clothing before researchers took their height and weight measurements. Objectively measured height and weight values were correlated with maternal reported weight and height values (collected on the same day of the home visit); Pearson’s correlations were .67 and .97 for child and mother’s BMI data, respectively.

**Measures of maternal psychopathology**

*Beck Depression Inventory – Short form.* [BDI-SF] (Beck & Beck, 1972). The BDI-SF is a 13-item self-report questionnaire that measures depressive symptomology. Respondents are asked to indicate their experience of symptoms over the past two weeks. Questions address symptoms such as sadness, disappointment, hopelessness, worthlessness, apathy, fatigue, concentration and suicidal ideation. Each question taps into a different symptom, and respondents are asked to select one of four choices, for example: I am not particularly discouraged about the future, I feel discouraged about the future, I feel I have nothing to look forward to, I feel that the future is hopeless and that things cannot improve. Each item is scored from 0-3 and summed to provide a total score out of 39.
The BDI-SF has shown good convergent validity with ICD-10 depression diagnostic criteria (Al-Yasiri & AbdKarkosh, 2013) and other self-reported depression scales (Reynolds & Gould, 1981), and high sensitivity and specificity in detecting moderate to severe depression (Furlanetto & Mendlowicz, 2005). It has also shown high correlations with the full 21 item version (Beck, 1988; Reynolds & Gould, 1981). The Cronbach’s alpha for the current sample was .72.

**Body dissatisfaction.** Two items were adapted from the Body Change Inventory [BCI] (McCabe & Ricciardelli, 2002) to measure satisfaction with body shape and weight. The items asked respondents “how satisfied are you with your weight” and “how satisfied are you with your body shape?” Self-evaluation of weight and shape has been found to be critical in predicting body dissatisfaction accurately (Cash, 1994). Each item was based on a 5-point Likert scale, ranging from 1 – extremely dissatisfied, to 5 – extremely satisfied. The total score for was summed to provide a satisfaction with weight/shape score, with higher scores indicating greater body satisfaction; scores ranged between 2-10. Cronbach’s alpha for this subscale within the present sample was .91, and the mean inter-item correlation was .83.

**State-Trait Anxiety Inventory – Trait Scale** [STAI-T] (Spielberger & Reheiser, 2009). The STAI-T is a 20-item scale designed to assess frequency of anxiety symptoms and cognitions as a stable personality trait. Example items include: “I get in a state of tension and/or turmoil as I think over my recent concerns and interests”, “I worry too much over something that doesn’t really matter”, and “I feel nervous and restless”. Items are scored 1-4, with respondents asked to rate each statement according to how they “usually feel”, ranging from 1 – “not at all” to 4 “very much so”. Total scores range from 20-80, with higher scores indicative of highly frequent and intense symptoms of anxiety. The scale has shown high test-
retest reliability, $r = .86$ (Rule & Traver, 1983; Spielberger, Gorsuch, & Lushene, 1970), good concurrent validity with the Anxiety Sensitivity Index, Anxiety Scale Questionnaire, and the Manifest Anxiety Scale (Spielberger & Reheiser, 2009; Spielberger, Reheiser, Ritterband, Sydeman, & Unger, 1995), and high construct validity (Spielberger & Reheiser, 2009). A Cronbach’s alpha of .90 was obtained in the current sample, which is consistent with internal consistency values provided by Spielberger and Reheiser (2009).

*Rosenberg Self-Esteem Scale* [RSE] (Rosenberg, 1965). This measure is a 10-item scale that measures global self-esteem and self-worth. Example items include: “on the whole I am satisfied with myself”, “I wish I could have more respect for myself”, “I am able to do things as well as most other people”. Respondents rate each item on a 4-point Likert scale, ranging from strongly agree to strongly disagree; the total score ranges from 10-40. This scale has shown moderate to high construct validity (.69) with self-reports and reports from peers, nurses, and ratings of depression and anxiety (Hagborg, 1993; Kaplan & Pokorny, 1969), and moderate to high convergent validity (.60 - .83) with the Health Self-Image Questionnaire (Silber & Tippett, 1965), the Coopersmith Self Esteem Inventory (Crandal, 1973), band the Global Self Worth Scale (Hagborg, 1993). Cronbach’s alpha was .88 in the present study.

**Measures of child feeding practices**

*Child Feeding Questionnaire – Restriction and Pressure subscales* [CFQ] (Birch et al., 2001). The CFQ is a questionnaire that examines parent feeding styles, and parental beliefs and concerns about child eating, feeding, and obesity. The Restriction subscale comprises eight items examining parental restriction of child food intake, particularly pertaining to junk food. Items include: “I have to be sure that
my child does not eat too many high-fat foods”, “I offer sweets (candy, ice cream, cake, pastries) to my child as a reward for good behaviour”, “If I did not regulate my child’s eating, he/she would eat too many junk foods”. The Pressure to Eat subscale consists of four items that measure parental encouragement of their child to eat more food than the child wishes to themself. Items include: “my child should always eat all of the food on his/her plate”, and “if my child says, ‘I’m not hungry’ I try to get him/her to eat anyway”. Each item is rated from 1 (disagree) to 5 (agree) and summed to provide a total subscale score. These subscales have shown predictive validity of poor self-regulation of eating in children five years later (Francis & Birch, 2005a), and confirmatory factor analysis has shown each subscale loads well onto individual factors, suggesting good construct validity (Birch et al., 2001). Within the validation sample (Birch et al., 2001), and an Australian sample (Corsini, Danthiir, Kettler, & Wilson, 2008a), restriction was positively correlated to child weight status, and pressure negatively correlated to child weight status, attesting to convergent validity of the subscales. However, Corsini et al. (2008) only found a positive relationship between restriction and higher BMI in male children. Corsini et al. (2008) point out that this measure may only be valid in mid-high income Caucasian families, as other research has failed to find associations between the CFQ restriction subscale and child obesity risks in more economically diverse samples (Campbell, Crawford, & Ball, 2006) and in non-Caucasian samples (Spruijt-Metz, Li, Cohen, Birch, & Goran, 2006). Both scales show moderate to high internal consistency, with reports ranging from .70-.80 for pressure, and .73-.83 for restriction (Birch et al., 2001; Corsini et al., 2008; Spruijt-Metz et al., 2006) In the current sample, the Restriction subscale yielded a Cronbach’s alpha of .75, and the Pressure subscale an alpha of .72, suggesting adequate reliability. Feeding practices were measured at study entry only (T1).
Preliminary data screening

The dataset was screened for missing values, internal consistency, and the statistical assumptions of regression and path analysis. Missing values analysis was first undertaken using SPSS Statistics 22. For Study One, the greatest percentage of missing data was found for family income and maternal work type (both 2.1%). Missing data were estimated using multiple imputation, as this is currently the gold standard method for dealing with missing data (Osborne, 2013), and allows analysis of the imputed datasets across multiple applications, including multiple regression and path analysis (Allison, 2003). In Study One, the percentage of missing data was low, thus five imputed datasets were generated to estimate missing values in accordance with recommendations by Graham, Olchowski, and Gilreath (2007). These datasets were then pooled for data screening, assumption testing and statistical analysis. In Study Two, Multiple Imputation was also used to estimate missing data, however, missing values for the outcome variable of child BMI-z score exceeded 30%. In accordance with recommendations by Schafer and Graham (2002) for outcomes variables missing more than 30% data, 20 separate imputed datasets were estimated via multiple imputation, and these datasets were pooled for data screening, assumption testing and statistical analysis.

Participants with univariate or multivariate outliers exceeding critical values were deleted (Study One: \( n = 8 \); Study 2: \( n = 11 \)). Univariate outliers were detected using SPSS Descriptives, via assessing the histograms, box plots and 5% trimmed mean for each variable in the model. Outliers greater than 3 standard deviations from the mean were first checked for error, and either amended or removed from the dataset. Multivariate outliers were detected using Mahalanobis distance; the critical chi-square was determined using number of independent variables in each study as
the degrees of freedom. Values within the dataset that exceeded the critical chi square were deemed multivariate outliers, and deleted from the dataset.

**Assumption testing**

Both hierarchical regression and path analysis assume normality, linearity, non-multicollinearity and homoscedacity. These assumptions were confirmed via residuals scatterplots (Tabachnick & Fidell, 2007). It has been reported that it is more crucial that the assumption of residual normality is met than normality of predictor and outcome variables within regression models (Tabachnick & Fidell, 2007; Williams, Gomez Grajales, & Kurkiewicz, 2013). Furthermore, the traditional test of normality, the Kolmogorov-Smirnov (K-S) statistic (generated in SPSS Statistics, v22) is said to be too sensitive in large samples, and that inspection of histograms and normal Q-Q plots are a better measure of normality (Pallant, 2011; Tabachnick & Fidell, 2007). A K-S value less than .05 suggests violation of the normality assumption, and in both Study One and Two, all variables yielded significant K-S statistics, with the exception of child BMI and child BMI-z. However, given the above reasoning, and the rationale that samples larger than 40 cases are robust to normality violations (Ghasemi & Zahediasl, 2012), parametric tests were deemed appropriate to use in the current sample. Skewness and kurtosis values are also said to be too sensitive in large samples ($N = 200+$), and inspection of the histograms is a better indication of normality (Tabachnick & Fidell, 2007). The histograms for each variable showed no evidence of skew or kurtosis in either Study One or Two. Furthermore, the skew and kurtosis scores for each variable did not exceed absolute values provided by West, Finch, and Curran (1995); >2.1 for skew and >7.1 for kurtosis. Absence of multicollinearity was confirmed via tolerance and VIF statistics, with all variables yielding tolerance values greater than .10, and VIF values less than
10 (Pallant, 2011). No outliers were present within the final sample, as these were identified and removed where necessary according to procedures outlined above.

The sample size for Study One was adequate for regression analysis ($N = 290$); according to Tabachnick and Fidell (2007), $N \geq 50 + 8m$, $m$ being the number of predictor variables in the regression model. For Study One, there were 11 predictor variables, meaning that 138 cases were needed to meet sample size requirements. For the path analysis in Study Two, the minimum recommended sample size is given by a ratio of 10:1 cases to free parameters in the model (Bentler & Chou, 1987). In the path model within Study Two, there were 16 degrees of freedom, meaning that a minimum of 160 participants were needed to obtain reliable results. This was well exceeded in the Study Two sample ($N = 279$). The path model yielded a power of .89, based on calculations from Preacher and Coffman (2006).

**Statistical analysis**

**Study One.** Pearson’s correlations were first undertaken to explore the cross-sectional associations between covariates, maternal psychopathology measures (BDI, STAI-T, RSE and BCI scores), maternal feeding practices (maternal Restriction and Pressure scores) and the outcome variable (child BMI-z scores). Hierarchical regressions were conducted to examine the relationships between maternal psychopathology, maternal-child feeding practices, and child BMI-z scores. Covariates were entered at Step 1, maternal feeding practices (restriction and pressure) at Step 2, and maternal psychopathology variables at Step 3; child BMI-z was the outcome variable. Independent t-tests were conducted to compare child BMI-z scores between mothers with normal and elevated psychopathology scores.

To compare child weight outcomes by mothers with high vs. low psychopathology scores, cut-off scores were calculated and employed. However,
there were no published cut-off scores applicable to our population for the scales used. For the BDI-II, the STAI-T and the RSE, scores two standard deviations from the means were used. To categorise mothers into normal or elevated categories, a cut-off of 8.89 was used for the BDI, 53.47 for the STAI-T and 42.34 for the RSE. For the shortened version of the BCI, the score range was too small to use the two standard deviation method; instead a cut-off of one standard deviation from the mean was used to dichotomise women into normal and elevated body dissatisfaction.

**Study Two.** Pearson’s correlations were undertaken to explore the cross-sectional associations between covariates (maternal BMI, family income, and maternal work status), maternal psychopathology (BDI, STAI-T, RSE and BCI scores), maternal feeding practices (maternal Restriction and Pressure scores) and child BMI-z change scores. Correlations were calculated using IBM SPSS Statistics 22, using the pooled estimate function with multiple imputation data.

A path analysis was employed to test the proposed model of maternal psychopathology, feeding practices and child BMI-z change (Figure 3.1). The path model was estimated using maximum likelihood estimation in AMOS. Model fit was tested via chi-square goodness-of-fit, comparative fit index: good fit >.95; Hu & Bentler, 1998), and the root mean square error of approximation (good fit <.06; Hu & Bentler, 1998). As stated earlier, missing data was dealt with using multiple imputation and as such 20 imputed datasets were created. As AMOS is unable to work with pooled multiple imputation data, the path model was run separately for each of the 20 datasets, and results of each separate path analysis were pooled to create an aggregate model. These calculations were computed by hand, in accordance with Schafer (1997). This involved recording the parameter estimates for each pathway within the model for each separate imputation. An average of the estimate
and its standard error was then calculated, and using these values, within and between imputation variances were calculated to provide a total variance value for each individual pathway within the model. The square root of the total group variance provided the multiple group standard error, and the mean pathway estimate was divided by this value to provide the critical ratio for each pathway. The mean estimate of the pathway was used to determine whether the pathway was significant. The model fit was then tested in accordance with guidelines for combining chi-square statistics calculations from (Allison, 2002). The chi-square values from the model output of each imputation were combined to provide an average value. The chi square value from each imputed data set, and the mean chi square value was squared and divided by the number of imputations to provide the sample variance. From these values, an equation to compute the proposed test statistic was computed, and this provided the critical $F$ value to test against the $F$ distribution, which determined whether the chi-square across imputations was or was not significant, and thus a good fit of the model.
References


Chapter Four

Empirical Study One: Maternal depressive and anxiety symptoms, self-esteem, body dissatisfaction and pre-schooler obesity: a cross-sectional study

Pree Benton¹, Helen Skouteris¹, Melissa Hayden¹

¹ School of Psychology, Deakin University, Melbourne, Australia

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Correspondence: Pree Benton, School of Psychology, Deakin University, 221 Burwood Highway, Burwood, Victoria, Australia, 3125. Email: pbento@deakin.edu.au*

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Abstract

The primary aim of the present study was to cross-sectionally examine the associations between maternal psychosocial variables, child feeding practices and preschooer BMI-z in children (aged 2-4 years). A secondary aim was to examine differences in child weight outcomes between mothers scoring above and below specified cut-offs on the psychosocial measures. 290 mother-child dyads were recruited from Melbourne, Australia, and completed questionnaires examining demographic information, mothers’ depressive and anxiety symptoms, self-esteem and body dissatisfaction, restrictive and pressure child feeding practices, and preschoolers’ BMI-z scores. Independent t-tests and hierarchical multiple regression were employed to analyse the data. In the final regression model, none of the maternal psychosocial measures or feeding practices predicted child BMI-z scores; maternal BMI and employment status were the only predictors of preschooler BMI-z. However, independent t-tests revealed that children of mothers with elevated body dissatisfaction scores had significantly higher BMI-z scores than children of mothers without elevated scores. The results suggest that psychosocial variables are not related, cross-sectionally, to pre-schooler weight outcomes, however further research is needed to replicate the group differences noted between mothers with and without body dissatisfaction, and to track these relationships longitudinally.
Introduction

Childhood obesity is well-recognised as a health epidemic (Batch & Baur, 2005; Deckelbaum & Williams, 2001), with an estimated 42 million children globally falling within the overweight or obese categories (World Health Organisation, 2015). Given the serious health implications of obesity, including increased risks of hypertension (Pott et al., 2009; Strauss et al., 2001), type 2 diabetes (Inge et al., 2007; Zeller et al., 2009), cardiovascular diseases (Ali et al., 2010; Gunnell et al., 1998; Kim et al., 2008), both during childhood and continuing into adulthood (Eddy et al., 2007a; Must et al., 1992; Power et al., 1997), great research efforts are being invested in prevention and intervention strategies (Luttikhuis et al., 2009; Waters et al., 2012).

While core factors such as diet and physical activity are undeniably linked to the formation of child obesity (Tremblay & Willms, 2003b), attention has shifted to considering proximal contributors that are external to the child, such as parental, social and cultural influences, media and marketing (Harrison et al., 2011; Lumeng et al., 2006). Research focusing on pre-school aged children is of particular interest, as this is a time where diet and physical activity patterns are firmly established (Birch & Fisher, 1998a; Dowda et al., 2003), and where children develop lasting patterns from dominant models in their lives, such as parents (Brown & Ogden, 2004; Scaglioni, Salvioni, & Galimberti, 2008; Ystrom et al., 2012a).

In particular, maternal contributors to child obesity have been heavily researched. These factors include attitudes to physical activity (Dowda et al., 2003; Gable & Lutz, 2000) beliefs relating to diet (Adedze, Chapman-Novakofski, Witz, Orr, & Donovan, 2011; Campbell & Crawford, 2001; Gable & Lutz, 2000), and child feeding practices (Birch, Fisher, & Davison, 2003a; Clark et al., 2007; Ventura & Birch, 2008). Child feeding practices have become a particular focus, with evidence
suggesting both maternal pressure to eat (Hurley et al., 2008a; Ystrom et al., 2012a),
and restriction of food intake (Clark et al., 2007; Faith & Kerns, 2005; Fisher &
Birch, 1999b; Francis et al., 2001; Ogden, Reynolds, & Smith, 2006) are associated
with an increased risk for excess weight gain in pre-school aged children (2 – 6
years). However, this relationship may be more complex than it appears; several
studies have found that the use of pressure and restrictive child feeding practices is
associated with maternal depressive and anxiety symptoms, and low self-esteem
(Duke et al., 2004; Haycraft & Blissett, 2008a; Haycraft & Blissett, 2012; Hurley et
al., 2008a; Ystrom et al., 2012a). There is also emerging evidence that maternal body
dissatisfaction is linked to increased restriction and pressure feeding practices
(Blissett & Haycraft, 2008; Francis et al., 2001; Rodgers et al., 2013; Tiggemann &
Lowes, 2002b). A systematic literature review by McPhie and colleagues (McPhie,
Skouteris, Daniels, & Jansen, 2012a) found support for a link between maternal eating
psychopathology (including body dissatisfaction) and increased pressure and
restrictive feeding practices. A more recent systematic review by Benton, Skouteris,
and Hayden (2015b) reported that maternal depressive symptoms are associated with
increased risks for preschooler obesity, and also identified that maternal anxiety and
body dissatisfaction have been shown to be related to preschooler obesity risks also.
However, the review only found two single studies that reported on these latter
constructs, and noted that no studies examined the relationship between maternal self-
esteem and preschooler obesity risk. Furthermore, the review noted that all but three
of the studies utilised cut-off scores on the maternal psychosocial measures to
compare mothers scoring above and below these cut-offs in relation to pre-schooler
weight outcomes. One study suggested that doing so improved the relevance and
interpretation of results (Burdette et al., 2003).
Therefore, in order to address the gaps in the literature identified Benton et al.’s (2015) systematic review, the current study was proposed to comprehensively examine the relationships between maternal psychosocial variables, child feeding practices, and child weight outcomes. Using a sample of Australian mothers and their pre-school aged children, the primary aim of the present study was to examine the associations between maternal depressive and anxiety symptoms, self-esteem and body dissatisfaction, child feeding practices, and BMI in preschool-aged children. It was hypothesised that higher scores on depressive and anxiety measures, lower scores on body satisfaction and self-esteem measures, and higher scores on restrictive and pressure to eat feeding practices would predict higher child BMI-z. A secondary aim of the study was to compare the BMI-z of children of mothers who appeared to display elevated depressive and anxiety symptoms, body dissatisfaction and low self-esteem, with those who scored within normal ranges on these measures. For depressive and anxiety symptomology, higher scores were indicated by scoring above identified cut-offs, whilst for body dissatisfaction and self-esteem, scores below identified cut-offs indicated poorer psychosocial health on these measures. It was hypothesised that children of mothers who appeared to be experiencing heightened depressive and anxiety symptoms, higher body dissatisfaction and lower self-esteem would have significantly higher BMI-z scores, compared to children of mothers with normal range scores.

**Materials and Method**

**Participants**

A total of 527 Australian mothers of pre-school aged children (2-4 years old) registered their participation in the present study. Of these, 298 (56.5%) returned
questionnaires. A further eight cases were identified as multivariate outliers and removed from the dataset. Thus, a total of 290 participants were included in the final analyses. Participants were all English speaking; there were no other exclusion criteria.

**Procedure**

Participants were recruited between 2010-2012 on a voluntary basis via advertisements placed in parenting magazines, posters displayed within metropolitan and rural kindergartens and child care centres in Victoria, Australia, and by word-of-mouth. Prospective participants expressed their interest and were subsequently posted consent forms, baseline questionnaire packs, which were completed at home. The study was approved by the Deakin University Human Research Ethics Committee.

**Measures**

**Child Anthropometry.** Child height in centimetres and weight in kilograms were reported by mothers, and these values were used to calculate children’s BMI and BMI z-scores. BMI was calculated according to the WHO Child Growth Standards for pre-schoolers (De Onis & Lobstein, 2010). A subsample of participants \((n = 65)\) participated in home visits, where researchers objectively collected both mothers’ and children’s weight and height, using electronic scales and a stadiometer, respectively. Objectively measured height and weight values were then correlated with maternal reported weight and height values (collected on the same day of the home visit). Pearson’s correlations were .67 and .97 for child and mother’s height and weight data, respectively.

**Maternal psychosocial measures**

**Maternal depressive symptoms.** The presence and severity of maternal
depressive symptoms were identified using the Beck Depression Inventory – Short form [BDI-SF] (Beck & Beck, 1972), a 13-item self-report questionnaire that measures depressive symptomology. Each item is scored from 0-3 and summed to provide a total score out of 39. The BDI-SF has shown good convergent validity with ICD-10 depression diagnostic criteria (Al-Yasiri & AbdKarkosh, 2013) and other self-reported depression scales (Reynolds & Gould, 1981). The BDI-SF has demonstrated high sensitivity and specificity in detecting moderate to severe depression (Furlanetto & Mendlowicz, 2005). For screening purposes, a cut-off score of 9/10 has been found suitable in medical inpatients, whilst a score or 13/14 should be used for high specificity in such samples (Furlanetto & Mendlowicz, 2005). Ranges have also been specified by the scale developers: 0-4 no depression or minimal; 5 -7 mild; 8 -15 moderate; 16+ severe (Beck & Beck, 1972). In a general population sample, mean scores were found to range between 2.16 (SD = 2.77) - 2.82 (SD = 3.54) in men and women aged between 16-89 (Knight, 1984). No recent norms or cut-offs for general population samples were found at the time of publication.

*Maternal body dissatisfaction.* For brevity, two items were adapted from the Body Change Inventory [BCI] (McCabe & Ricciardelli, 2002), which measured satisfaction with body shape and weight. The items asked respondents “how satisfied are you with your weight” and “how satisfied are you with your body shape?”. Self evaluation of weight and shape has been found to be critical in predicting body dissatisfaction accurately (Cash, 1994). Each item was based on a 5-point likert scale, and the total score for was summed to provide a satisfaction with weight/shape score, with higher scores indicating greater body satisfaction. Scores ranged between 2-10. Cronbach’s alpha for this subscale within the present sample was .91, and the mean inter-item correlation was .83.
**Maternal anxiety symptoms.** This construct was measured by the State-Trait Anxiety Inventory – Trait Scale [STAI-T] (Spielberger & Reheiser, 2009), a 20-item scale designed to assess frequency of anxiety symptoms and cognitions as a stable personality trait. The Trait form was used to examine the impact of more pervasive anxiety symptomology (as a personality trait) on pre-schooler weight outcomes, as opposed to anxiety relating to a particular event or point in time, which the State form measures. Items are scored 1-4, and scores range from 20-80, with higher scores indicative of highly frequent and intense symptoms of anxiety (Spielberger & Reheiser, 2009). In an Australian adult population, a mean of 36.35 ($SD = 11.39$) has been reported (Crawford et al., 2009). A cut-off of 54 has been specified as indicative of detecting anxiety disorders in a geriatric sample (Kvaal, Ulstein, Nordhus, & Engedal, 2005). The scale has shown high test-retest reliability, $r = .86$ (Rule & Traver, 1983), good concurrent validity with the Anxiety Sensitivity Index, Anxiety Scale Questionnaire, and the Manifest Anxiety Scale (Spielberger & Reheiser, 2009; Spielberger et al., 1995), and high construct validity. A Cronbach’s alpha of .90 was obtained in the current sample.

**Maternal self-esteem.** Mothers’ self-esteem levels were measured using the Rosenberg Self-Esteem Scale [RSE] (Rosenberg, 1965). A 10-item scale that measures global self-esteem and self-worth. Each item is rated on a 4-point likert scale ranging from strongly agree to strongly disagree; the total score ranges from 10-40. Norms for Australian adult samples could not be found at time of publication. This scale has shown high internal and test-retest reliability, and good construct validity (Robins, Hendin, & Trzesniewski, 2001). Cronbach’s alpha was .88 in the present study.
Measures of child feeding practices

*Child Feeding Questionnaire – Restriction and Pressure subscales* [CFQ] (Birch et al., 2001). A measure that examines different parent feeding styles or behaviours, and parental beliefs and concerns about child eating, feeding, and obesity. The Restriction subscale comprises eight items examining parental restriction of child food intake. The Pressure to Eat subscale included four items that measure parental regulation of child eating. Each item is rated from 1 (disagree) to 5 (agree) and averaged to provide a total subscale score. In the current sample, the Restriction subscale yielded a Cronbach’s alpha of .75, and the Pressure subscale an alpha of .72, suggesting adequate reliability.

**Covariates.** Maternal BMI, level of education, employment status, family income bracket, and child sex were measured via maternal self-report, using a questionnaire developed by the researchers. Level of education was categorised as: still at secondary school, did not finish secondary school, Year 12 or equivalent, Certificate level, Advanced Diploma/Diploma, Graduate Diploma/Graduate Certificate, Bachelor Degree, or Postgraduate Degree. Family income was categorised in brackets: under $25,000, $25,001-$45,000, $45,001-$65,000, $65,001-$85,000, $85,001-$105,000, $85,001-$105,000, $105,001-$125,000, $125,001-$145,000, and over $145,001. Employment status was dichotomously measured (yes/no), and maternal BMI was measured as a continuous numerical value. These covariates were included based on recommendations from a recent systematic review that examined the relationship between maternal psychopathology and pre-schooler obesity risk (Benton et al., 2015).

**Statistical Analysis**
Hierarchical regressions were conducted to examine the relationships between maternal psychosocial variables, maternal-child feeding practices, and child BMI-z scores. Covariates were entered at Step 1, maternal feeding practices (restriction and pressure) at Step 2, and maternal psychosocial variables at Step 3; child BMI-z was the outcome variable. Independent t-tests were conducted to compare child BMI-z scores between mothers with normal and lower psychosocial variable scores. These secondary analyses were included to allow comparison with studies included in the Benton et al. (2015) systematic review. Four of these studies (Burdette et al., 2003; Gross et al., 2013; Grote et al., 2010; Santos, Matijasevich, Domingues, Barros, & Barros, 2010a) included such analyses in addition to their multivariate analyses to further examine the relationship between maternal psychosocial variables at the more severe end of the spectrum, and pre-schooler weight outcomes.

There were no published cut-off scores applicable to an Australian adult population for the scales used. For the BDI-II, the STAI-T and the RSE, scores two standard deviations from the means were used. To categorise mothers into normal or elevated categories, a cut-off of 8.89 was used for the BDI, 53.47 for the STAI-T and 42.34 for the RSE. These cut-offs were consistent with those reported above for the BDI and STAI-T in other samples (Beck & Beck, 1972; Kvaal et al., 2005; Furlanetto & Mendlowicz, 2005). For the shortened version of the BCI, the score range was too small to use the two standard deviation method; instead a cut-off of one standard deviation from the mean was used to dichotomise women into normal and elevated body dissatisfaction, which was \( \leq 3.5 \). Therefore, scores referred to as elevated in the remainder of the paper are defined as two standard deviations from the sample mean for depressive and anxiety symptoms, and self-esteem, and one standard deviation for the sample mean for body dissatisfaction.
Results

Preliminary Data Analysis

The dataset was screened for missing values, internal consistency, and the statistical assumptions of regression. Missing data were estimated using multiple imputation on SPSS Statistics 22. None of the variables had more than 2% missing data. Participants with univariate or multivariate outliers exceeding critical values were deleted \( (n = 8) \).

Participant Characteristics

Demographic information is presented in Table 4.1. The mean maternal age was 35.8 \( (SD = 4.2) \), and the majority of participants were born in Australia or New Zealand (84.4%). Just over half of the mothers were currently employed, the majority were tertiary educated; and the most commonly reported income bracket was $85 001 - $105 000 AUD. The majority of the sample was married. Half the mothers’ BMI’s (51%) fell within normal range; 35% were in the overweight range, and an additional 12.5% in the obese range. Children had a mean age of 2.9 \( (SD = .75) \) and just under half were male. Child BMI-z ranged from -5.91 to 3.23 , \( (M = -.04, SD =1.3) \). The majority of children fell within the normal weight BMI category (72.1%); 12.2% were categorised as overweight and a further 2.4% as obese. The prevalence of mothers scoring beyond the cut-offs was low across all four measures; body dissatisfaction yielded the highest percentage of mothers scoring beyond the cut-off (Table 4.2). Maternal body dissatisfaction was the most prevalent of the four indices.
### Participant demographic characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean maternal age</td>
<td>35.8 (4.2)</td>
</tr>
<tr>
<td>Mean maternal BMI (kg/m²)</td>
<td>25.3 (4.5)</td>
</tr>
<tr>
<td>Maternal BMI categories, %</td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>2 (N = 5)</td>
</tr>
<tr>
<td>Healthy</td>
<td>51 (N = 146)</td>
</tr>
<tr>
<td>Overweight</td>
<td>34.5 (N = 99)</td>
</tr>
<tr>
<td>Obese</td>
<td>12.5 (N = 36)</td>
</tr>
<tr>
<td>Maternal BMI categories, %</td>
<td></td>
</tr>
<tr>
<td>Married/de facto</td>
<td>95.9 (N = 275)</td>
</tr>
<tr>
<td>Divorced/separated/widowed/never married</td>
<td>4.1 (N = 12)</td>
</tr>
<tr>
<td>Maternal marital status, %</td>
<td></td>
</tr>
<tr>
<td>Married/de facto</td>
<td>95.9 (N = 275)</td>
</tr>
<tr>
<td>Divorced/separated/widowed/never married</td>
<td>4.1 (N = 12)</td>
</tr>
<tr>
<td>Maternal SES³, %</td>
<td></td>
</tr>
<tr>
<td>Family income ≥ $85,001 AUD</td>
<td>63.9 (N = 185)</td>
</tr>
<tr>
<td>Maternal education ≥ bachelor degree</td>
<td>66.9 (N = 192)</td>
</tr>
<tr>
<td>Maternal current employment</td>
<td>56.1 (N = 161)</td>
</tr>
<tr>
<td>Maternal country of birth, %</td>
<td></td>
</tr>
<tr>
<td>Australia or New Zealand</td>
<td>84.4 (N = 242)</td>
</tr>
<tr>
<td>Europe</td>
<td>8.4 (N = 24)</td>
</tr>
<tr>
<td>Asia</td>
<td>2.8 (N = 8)</td>
</tr>
<tr>
<td>Other</td>
<td>4.4 (N = 13)</td>
</tr>
<tr>
<td>Mean child age, years</td>
<td>2.9 (SD = .7)</td>
</tr>
<tr>
<td>Male children, %</td>
<td>43.9 (N = 126)</td>
</tr>
<tr>
<td>Child weight variables</td>
<td></td>
</tr>
<tr>
<td>Mean child weight, kg</td>
<td>14.89 (2.6)</td>
</tr>
<tr>
<td>Mean child BMI, kg/m²</td>
<td>16.2 (1.6)</td>
</tr>
<tr>
<td>Mean child BMIz score²</td>
<td>-.04 (1.3)</td>
</tr>
<tr>
<td>Child BMI categories, %</td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>13.2 (N = 35)</td>
</tr>
<tr>
<td>Healthy</td>
<td>72.1 (N = 207)</td>
</tr>
<tr>
<td>Overweight</td>
<td>12.2 (N = 36)</td>
</tr>
<tr>
<td>Obese</td>
<td>2.4 (N = 7)</td>
</tr>
</tbody>
</table>

¹BMI, body mass index; ²BMIz, body mass index z-score; ³SES, socio-economic status; ⁴child BMI based on WHO Child Growth Standards for pre-schoolers (De Onis & Lobstein, 2010).

### Means, standard deviation and percentages of elevated scores for maternal psychopathology variables

<table>
<thead>
<tr>
<th></th>
<th>BDI</th>
<th>STAI-T</th>
<th>RSE</th>
<th>BCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD)</td>
<td>3.32 (2.77)</td>
<td>36.35 (11.39)</td>
<td>32.72 (4.81)</td>
<td>5.75 (2.28)</td>
</tr>
<tr>
<td>% elevated</td>
<td>5.5</td>
<td>3.5</td>
<td>0</td>
<td>15.9</td>
</tr>
<tr>
<td>Range of scores</td>
<td>0-25</td>
<td>18-37</td>
<td>21-66</td>
<td>2-10</td>
</tr>
</tbody>
</table>
**Regression Analyses**

Hierarchical multiple regression was employed to test whether maternal psychosocial variables (depressive and anxiety symptoms, self-esteem and body satisfaction) and restrictive and pressure child feeding practices significantly predicted child BMI-z scores, controlling for identified covariates (child gender, family income, maternal BMI, education, and employment) as per previous research (Benton et al., 2015). Assumptions of normality, linearity, multicollinearity and homoscedasticity were met. Results are presented in Table 3. At Step 1 (covariates only), the model approached significance and explained 3.9% of the variance in child BMI-z. At Step 2, pressure and restrictive feeding practices were entered, explaining an additional 0.5% of the variance in child BMI-z: $R^2$ change = .009, $F$ change $(2, 283) = 1.35, p = .26$. The total variance explained by the model at Step 2 was 4.8%, $F(7, 283) = 2.02, p = .05$. At the final step, maternal psychosocial variables accounted for a further 0.7% of child BMI-z variance, however the contribution was not significant: $R^2 = .055, F$ change $(4, 279) = .52, p = .72$. The full model explained 5% of the variance in child BMI-z scores, $F(11, 279) = 1.47, p = .14$. In the final model, only maternal BMI ($beta = .14, p = .02$) and employment status ($beta = -.12, p = .04$) made significant unique contributions to child BMI-z.
Table 4.3
Hierarchical regression of covariates, child feeding practices and maternal mental health as predictors for child BMI-z score

<table>
<thead>
<tr>
<th>Variables</th>
<th>t</th>
<th>p</th>
<th>β</th>
<th>F</th>
<th>df</th>
<th>p</th>
<th>Adj. R²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1: Covariates</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal BMI</td>
<td>2.40</td>
<td>.02</td>
<td>.14</td>
<td>2.24</td>
<td>5</td>
<td>.05</td>
<td>.02</td>
</tr>
<tr>
<td>Maternal Marital Status</td>
<td>.60</td>
<td>.55</td>
<td>.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal Education</td>
<td>-.40</td>
<td>.69</td>
<td>-.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual family income</td>
<td>1.09</td>
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<td>-.12</td>
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<td><strong>Step 2: Feeding practices</strong></td>
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<td>Restriction</td>
<td>.21</td>
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<td>2.0</td>
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<td>Pressure to eat</td>
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<td>BDI</td>
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<td>1.43</td>
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<td>STAI-T</td>
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<td>RSE</td>
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<td>.67</td>
<td>.03</td>
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Note: The dependent variable for all regressions was Child BMI-z score

Comparisons of Child BMI-z in Mothers Scoring Beyond Cut-offs on Psychosocial Measures

Independent samples t-tests were employed to compare the BMI-z scores of children whose mothers scored beyond cut-offs, compared to children of mothers who did not score beyond the cut-offs on the psychosocial measures. Cut-off scores were two standard deviations from the sample mean for the BDI, STAI, and RSE, and one standard deviation from the sample mean for the BCQ (see method section). There were no significant differences in child BMI-z scores between children of mothers with elevated and normal range scores on the BDI and STAI-T, or between mothers with significantly low and normal range self-esteem ($p > .05$). However, there was a significant difference for the BCI, with mothers showing elevated body dissatisfaction having children with higher BMI-z scores ($M = .11$, $SD = 1.23$), compared to mothers without elevated BCI scores ($M = -.05$, $SD = 1.35$), $t(288) = 2.01$, $p < .05$. 
Discussion

The aim of the present study was to examine the relationship between maternal psychosocial variables and pre-schooler weight outcomes. It was hypothesised that scores on maternal psychosocial measures, including depressive and anxiety symptoms, body dissatisfaction and low self-esteem, and restriction and feeding practices, would predict higher child BMI-z scores. Independent t-tests found that mothers with higher body dissatisfaction scores were more likely to have children with higher BMI-z scores; however, mothers with lower scores on the other measures of psychosocial indices were no more likely to have children with higher BMI-z scores. The full regression model did not significantly predict child BMI-z scores. Maternal BMI scores and employment status were the only variables that significantly predicted child BMI-z scores in the model.

The finding that children of mothers with elevated body dissatisfaction scores had significantly higher BMI-z scores is novel, with the current study being the first to examine the direct relationship between maternal body dissatisfaction and pre-schooler weight outcomes. The only other study known to the authors that examines maternal body dissatisfaction in relation to pre-schooler weight gain found that maternal body dissatisfaction significantly predicted maternal dietary restraint, which significantly predicted pre-schooler BMI-z change over two years in a positive direction, within a path model. The current study did not examine maternal disordered eating behaviours, but the consideration of such variables in future research may provide richer results.

No significant associations were found between maternal depressive symptoms and child BMI-z, which is consistent with several previous studies that
have also reported no association (Duarte et al., 2012; Phelan et al., 2011; Wojcicki et al., 2011). These studies also reported only small percentages (<10%) of mothers displaying elevated depressive symptomology, and two of these studies also recruited from only single cities. Therefore, results may be based on a restricted range of mothers experiencing elevations in depressive symptoms. These null findings are however, largely inconsistent with the literature. A recent systematic review of maternal psychopathology and risks for child overweight/obesity by Benton et al. (2015) found the majority of studies (79%) measuring maternal depressive symptoms reported at least partial support for a link between this variable and overweight/obesity risks in pre-schoolers. Of note, many of these studies reported a higher prevalence of elevated maternal depressive symptomology than the current study, and included nationally representative samples, suggesting they may have had a broader range of mothers with elevated depressive symptoms within their sample.

The null findings regarding the relationship between maternal anxiety symptoms and child BMI-z were inconsistent with those of Guxens et al. (2013), who reported maternal anxiety predicted child overweight at age four, although after adjusting for ethnicity, this relationship become non-significant. Converse to the current Australian sample, Guxens et al.’s study consisted of a predominantly Dutch sample, with the highest levels of child obesity present in participants of Turkish and Moroccan background. However no post-hoc tests were employed to examine which ethnicities held the strongest influence over the relationship between maternal anxiety and child obesity, thus it is difficult to comment on the role of ethnicity. Given that there is limited research examining the relationship between maternal anxiety symptoms and pre-schooler obesity, further research is needed to clarify these findings. There is also a paucity of research investigating the relationship between
maternal self-esteem and pre-schooler obesity, therefore based on the current findings alone, it is unclear whether self-esteem is/is not an important risk factor. A recent study by Mehta, Siega-Riz, Herring, Adait, and Bentley (2011) examined whether maternal self-esteem predicted failure to initiate breast-feeding (a risk for child obesity. Self-esteem was found to have no impact on breastfeeding and thus the authors concluded that self-esteem may not be an important factor in the risk between maternal psychosocial variables and child overweight/obesity.

The lack of association between feeding practices and child BMI-z is consistent with several studies of pre-schooler samples (Gemmil, Worotniuk, Holt, Skouteris, & Milgrom, 2013; Gregory, Paxton, & Brozovic, 2010; Rodgers et al., 2013). Previous research has reported strong associations between restriction and higher child BMI (Birch & Fisher, 2000; Clark et al., 2007; McPhie et al., 2012b; Ventura & Birch, 2008), and pressure feeding has been associated with lower child BMI, however, these studies were not limited to pre-school aged children. Investigations of feeding practices over childhood have reported no relationship in the pre-school years, but significant relationships are present once the children move beyond these years (Birch et al., 2003a; Webber, Hill, Cooke, Carnell, & Wardle, 2010b). Thus the cross-sectional nature of the current study may not entirely represent the relationship between feeding practices and child BMI-z, as the interaction may still be developing during the preschool years and not become apparent until later childhood.

With regard to the covariates, the significant relationship between maternal BMI and child BMI-z scores is consistent with past research (Lean, 2010; Whitaker et al., 2010). Interestingly, current results indicated that children of mothers who were currently employed tended to have higher BMI-z scores than children of non-working
mothers. Research has shown that maternal work hours may increase the risk of child obesity between 12 -35%, and it has been estimated that the increased rates of mothers in the workforce between 1968 and 2001 accounts for 10.4% of the current child obesity epidemic (Courtemanche, 2009). A large European study that found small associations between child body fat indices and maternal full-time employment, but no relationships were present when examining part-time employment (Gwozdz et al., 2013). Similarly, Cawley and Liu (2012) reported that working mothers of children aged up to five (compared with non-working mothers) spend 17 minutes less cooking, 10 minutes less eating with their children, 4 minutes less supervising children, and 37 minutes less caring for their children on a daily basis, and were more likely to feed their children pre-prepared food. Thus mothers engaged in employment may have less available time to prepare healthy meals for their children.

The present study is limited by several factors that must be taken into consideration. Firstly, as the study is a cross-sectional design, causality cannot be inferred. Interestingly, Duarte et al. (2011) found no relationship between maternal depressive symptoms and child BMI during the preschool years, however longitudinal analyses found maternal depressive symptoms at baseline predicted increases in child BMI at 3rd and 5th grades. Thus longer follow-up may be needed in order to examine the full picture. Additionally, we measured depressive symptoms only at a single time point. Other research (Santos et al., 2010a; Wang et al., 2013a) has found chronic depression (i.e. presence of symptoms across several measurement points), but not episodic depressive symptoms (measured at single time points), predicted child overweight and obesity. Secondly, the final regression model was not significant overall, and the explained only a small percentage of the variance in child BMI-z. The findings of the final regression only revealed that maternal BMI and employment
predicted child weight outcomes, which has been demonstrated in previous literature. Although the findings regarding maternal body dissatisfaction were novel, these were revealed by t-tests that did not control for covariates, and therefore may be biased. Further research is needed to explore these associations further. Thus, the current study replicates existing research, but does not extend the knowledge in the field with robust data.

As outlined in the results section, mothers in the current sample were predominantly high socioeconomic status (high family income, high education and currently employed). This prevents generalizability of the results to mothers of lower socioeconomic status. These demographic factors may also account for our null findings, as child overweight and obesity are inversely correlated with parental income and education in developed countries (Lamerz et al., 2005; Parsons, Power, Logan, & Summerbell, 1999; Wang, 2001). It is also possible that the high socioeconomic status of our sample might buffer against the impact of maternal mental health issues on child weight outcomes, via access to better resources such as health care access, availability of healthy food, neighbourhood resources, social support, etc., (Lampard et al., 2014). It should also be noted that the results of the current study were based on a convenience sample who volunteered their participation, and that the response rate for surveys mailed out was 56%. Previous research has noted participation bias in favour of those with higher SES and educational attainment (Lissner et al., 2003). Thus, the current sample may not capture the entire spectrum of mothers with psychosocial health issues, or children with overweight and obesity.

Furthermore, the use of maternal reported child BMI data may leave room for error and thus is a limitation of the current study. Previous research has demonstrated that whilst inaccuracies in parental reports of height and weight data or pre-schoolers
exist, they were not significantly different to independent measurement (O'Connor & Gugenheim, 2011). In the current sample, maternal report and independent measurement of child BMI data were moderately correlated ($r = .67$) in a subsample of participants. Whilst a stronger correlation is ideal, this is based on a restricted range of participants, and thus may not truly reflect the relationship between subjective and objectively measured child BMI data. Nonetheless, future studies must aim to address this limitation by objectively measuring child height and weight.

This was the first study (to the authors’ knowledge) to examine a range of maternal psychosocial variables in relation to pre-schooler weight outcomes. The study comprised a large sample, included known covariates and measured their relationship to preschooler weight outcomes. Maternal body dissatisfaction, maternal BMI and employment status all evidenced significant relationships to pre-schooler BMI-z scores, confirming previous research and identifying important variables on which to focus prevention and intervention efforts of child obesity. Although we did not find associations between pre-schooler weight outcomes and maternal depressive and anxiety symptoms and self-esteem, this may suggest that in high socioeconomic populations within a developed country, these maternal factors are not risk factors for pre-schooler obesity. Longitudinal research of these variables would also be useful to examine the pattern of relationships over time as the children approach late childhood and adolescence, and to enable causal conclusions to be drawn. The findings from the present study can be used to inform prevention and intervention strategies for child overweight and obesity, namely through the consideration of maternal body dissatisfaction, BMI, and employment status as possible risk factors for pre-schooler excess weight.
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Chapter Five

Empirical Study Two

Maternal psychosocial indices, feeding practices and pre-schooler obesity risk: A prospective longitudinal study

Pree Benton¹, Helen Skouteris¹, Melissa Hayden¹, Skye McPhie¹
¹ School of Psychology, Deakin University, Melbourne, Australia

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Correspondence: Pree Benton, School of Psychology, Deakin University, 221 Burwood Highway, Burwood, Victoria, Australia, 3125. Email: pbento@deakin.edu.au

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Abstract

The aim of the present study was to examine prospectively the longitudinal associations between maternal psychosocial variables (depressive and anxiety symptomology, self-esteem and body dissatisfaction), pressure and restrictive child feeding practices, and risks for pre-schooler obesity (child BMI-z change) over two years. A secondary aim was to examine differences in child weight outcomes between mothers scoring above and below specified cut-offs on the psychosocial measures. Participants were 290 mother-child dyads from Melbourne, Australia. Questionnaires examining demographic information, maternal psychosocial variables, feeding practices, and pre-schoolers’ BMI data were completed at baseline (child mean age: 34.8 months). Pre-schoolers’ BMI data was again obtained approximately two years later (child mean age: 63.3 months). Relationships were tested via path analysis and t-tests. At two-year follow-up, the findings of a path analysis revealed that although the proposed model was a good fit, only family income significantly predicted child BMI-z score change, in a positive direction. Neither maternal psychosocial variables nor child feeding practices were significant predictors of pre-schoolers’ obesity risk. Independent t-tests found no differences in BMI-z change between children of mothers scoring within and beyond cut-offs on the psychosocial measures. Results suggested that in a high socio-economic sample with a low prevalence of child overweight/obesity, maternal psychosocial health is not related to obesity risk in pre-school children longitudinally. However, further research is needed to replicate these findings in broader, socio-economically diverse populations with wider variations in child anthropometry and maternal psychosocial health.
Introduction

Maternal influence on pre-schooler obesity has been widely researched in the endeavour to prevent and intervene in the childhood obesity epidemic (Harrison et al., 2011; Lumeng et al., 2006). The pre-school years (2-6 years) are of particular interest, as this is a time where diet and physical activity patterns are firmly established (Birch & Fisher, 1998a; Dowda et al., 2003), and where children develop lasting patterns from dominant models in their lives, such as parents (Brown & Ogden, 2004; Scaglioni et al., 2008; Ystrom et al., 2012a).

Harrison et al.’s (2011) ecological model of child obesity provides a strong psychosocial framework for the model proposed in the current study. This model posits that child weight is influenced by several overarching layers: at the core are genetics and biological factors; the next layer being the child’s own characteristics such as preferences, temperament; and the next layer ‘clan’, referring to the influence of the family over the child’s weight. This may include parental attitudes to food and exercise, modelling of healthy or unhealthy attitudes, and feeding practices. The model discusses how at younger ages, children’s weight is more heavily influenced by the layers closest to the core (i.e., child and clan), and as they move into late childhood and adolescence, the outer layers, which include community, country and culture, become more influential over weight related factors. As the child obesity rates increase to epidemic proportions (Australian Institute of Health and Welfare, 2004), it is crucial that research begins to examine factors specific to the parents as individuals that may have previously been overlooked.

Several maternal factors have been associated with pre-schooler obesity risks, including attitudes to physical activity (Dowda et al., 2003; Gable & Lutz, 2000),
beliefs relating to diet (Adedze et al., 2011; Campbell & Crawford, 2001; Gable & Lutz, 2000), and child feeding practices (Bergemeier, Skouteris, Horwood, Hooley, & Richardson, 2014; Birch et al., 2003a; Clark et al., 2007; McPhie et al., 2012b; Ventura & Birch, 2008). Associations have been well documented between excess weight gain in pre-schoolers and maladaptive child feeding practices; specifically maternal pressure to eat (Hurley et al., 2008a; Ystrom et al., 2012a), and restriction of child food intake (Clark et al., 2007; Faith & Kerns, 2005; Fisher & Birch, 1999b; Francis et al., 2001; Ogden et al., 2006). Adding complexity to this relationship, maladaptive child feeding practices may be influenced by maternal psychosocial variables, with several studies demonstrating a link between the use of pressure and restrictive child feeding practices and maternal depressive and anxiety symptoms, and low self-esteem (Duke et al., 2004; Haycraft & Blissett, 2008a; Haycraft & Blissett, 2012; Hurley et al., 2008a; Ystrom et al., 2012a). Maternal body dissatisfaction has also been associated with increased restriction and pressure feeding practices (Francis et al., 2001; Rodgers et al., 2013; Tiggemann & Lowes, 2002b).

In addition to a possible indirect link to pre-schooler obesity via feeding practices, maternal psychosocial variables may also have a direct association with pre-schooler obesity. A recent systematic review (Benton et al., 2015b) reported that the majority of reviewed studies (79%) found maternal depressive symptoms were associated with greater pre-schooler obesity risks, which included weight outcomes, physical activity and TV viewing time. Only single papers examined the relationships between maternal anxiety (Guxens et al., 2013) and body dissatisfaction (Rodgers et al., 2013) with child obesity risk, however these both reported significant positive associations between maternal psychosocial measures and pre-schooler weight outcomes. The review identified the paucity of research into the relationship between
pre-schooler obesity risk and maternal psychosocial variables other than maternal depressive symptoms, with only two out of the 20 reviewed studies examining such indices. Given that these studies reported positive associations with pre-schooler obesity risk, it is important that further research addresses this gap in the literature.

Furthermore, the systematic review by Benton et al. (2015b) reported that all but three of the 18 studies included for review employed cut-off scores for the measures of maternal and anxiety depressive symptoms; the single study that measured body dissatisfaction did not employ cut-off scores (Rodgers et al., 2013). Moreover, more than half of the reviewed studies included between-group analyses that compared obesity risks in children of mothers with elevated psychopathology scores to those with lower scores. One study reported a two-fold risk of pre-schooler overweight in children who have mothers with elevated depressive symptoms compared to children of mothers with normal range scores (Surkan et al., 2008). Another study suggested that employing cut-off scores and comparing groups above and below these improved the relevance and interpretation of results (Burdette et al., 2003). These results suggest it is important to compare mothers with elevated psychopathology scores to mothers with normal range scores when examining the association of these variables to pre-schooler BMI, as this may help to better understand whether maternal psychopathology plays a role in the rise in child obesity rates.

To address the gaps in the literature mentioned above, Benton et al. (2015a) conducted a cross-sectional study examining the relationships between maternal psychosocial variables (depressive and anxiety symptoms, body dissatisfaction and self-esteem), child feeding practices (restriction and pressure), and pre-schooler weight outcomes in an Australian sample. They found that while none of the maternal
psychosocial measures or feeding practices cross-sectionally predicted pre-schooler BMI-z scores, significantly more mothers with elevated body dissatisfaction scores (greater than one standard deviation from the mean) had children with higher BMI-z scores than children of mothers without elevated body dissatisfaction. Maternal BMI and employment status also cross-sectionally predicted pre-schooler BMI-z. However, the cross-sectional nature of this study limited the inference of causality.

The aim of the current study was to extend Benton et al.’s (2015a) cross-sectional study by prospectively examining the longitudinal associations between maternal depressive and anxiety symptoms, self-esteem and body dissatisfaction, child feeding practices, and BMI-z change in the same sample of Australian mothers and pre-schoolers 24 months post-baseline measurement. These associations were tested within a path model (Figure 5.1). It was hypothesised that demographic variables (family income, maternal BMI and employment status) would predict maternal psychosocial indices, which in turn would predict restriction and pressure feeding practices, which subsequently would predict pre-schooler BMI-z score change at 24 month follow-up. Based on findings of Benton et al. (2015a), it was also predicted that maternal body dissatisfaction would directly predict child BMI-z change scores.

A secondary aim of the study was to compare the BMI-z change of children of mothers with poorer scores on the psychosocial measures, compared to those not scoring beyond cut-offs. For depressive and anxiety symptomology, higher scores were indicated by scoring above identified cut-offs, whilst for body dissatisfaction and self-esteem, scores below identified cut-offs indicated poorer psychosocial health on these measures. It was hypothesised that children of mothers who appeared to be experiencing heightened depressive and anxiety symptoms, higher body
dissatisfaction and lower self-esteem would have significantly greater BMI-z change scores, compared to children of mothers with normal range scores.

Figure 5.1. Proposed path model

**Method**

**Participants**

A total of 527 Australian mothers of pre-school aged children (2-4 years old) registered their interest in participation in the present study. Of these, 298 (56.5%) returned questionnaires at baseline. Upon inspection, 19 cases were identified as multivariate outliers and removed from the dataset, leaving 279 participants. At 24-month follow-up, 80 participants did not return questionnaires (27.6%), and a further 13 participants did not provide child BMI data (total 33% missing data for the outcome variable). Multiple imputation was employed to estimate missing data for these participants, thus a total of 279 participants were included in the final analyses. Participants were all English speaking; there were no other exclusion criteria.

**Procedure**

Participants were recruited between 2010-2012 on a voluntary basis via advertisements placed in parenting magazines, posters displayed within metropolitan and rural kindergartens and child care centres in Victoria, Australia, and by word-of-
mouth. Prospective participants expressed their interest and were subsequently posted consent forms, baseline questionnaire packs, which were completed at home at study entry (Time 1: T1; child mean age: 34.8 months, SD: 8.4 months), and follow-up questionnaires were mailed out approximately two years later (Time 2: T2; child mean age: 63.6 months, SD: 14.4 months). The mean time between measurements was 26 months (SD: 10 months). The study was approved by the Deakin University Human Research Ethics Committee.

Measures

Child anthropometry. Child height in centimetres and weight in kilograms were reported by mothers, and these values were used to calculate children’s BMI and BMI z-scores at T1 and T2. BMI was calculated according to the WHO Child Growth Standards for pre-schoolers (De Onis, Onyango, Borghi, Siyam, & Pinol, 2006). A subsample of participants (n = 65) participated in home visits, where researchers objectively collected both mothers’ and children’s weight and height, using electronic scales and a stadiometer. Objectively measured height and weight values were correlated with maternal reported weight and height values (collected on the same day of the home visit); Pearson’s correlations were .67 and .97 for child and mother’s height and weight data, respectively. BMI-z change scores between T1 and T2 were utilised as the outcome variable of the model. Change scores have shown to be reliable when used as dependent variables, without regression towards the mean (Allison, 1990).

Maternal psychosocial measures. All maternal psychosocial variables were measured at study entry only (T1).

is scored from 0-3 and summed to provide a total score out of 39. The BDI-SF has shown good convergent validity with ICD-10 depression diagnostic criteria (Al-Yasiri & AbdKarkosh, 2013) and other self-reported depression scales (Reynolds & Gould, 1981). The BDI-SF has demonstrated high sensitivity and specificity in detecting moderate to severe depression (Furlanetto & Mendlowicz, 2005). For screening purposes, a cut-off score of 9/10 has been found suitable in medical inpatients, whilst a score or 13/14 should be used for high specificity in such samples (Furlanetto & Mendlowicz, 2005). Ranges have also been specified by the scale developers: 0-4 no depression or minimal; 5 -7 mild; 8 -15 moderate; 16+ severe (Beck & Beck, 1972). In a general population sample, mean scores were found to range between 2.16 ($SD = 2.77$) - 2.82 ($SD = 3.54$) in men and women aged between 16-89 (Knight, 1984). No recent norms or cut-offs for general population samples were found at the time of publication. The Cronbach’s alpha for the current sample was .72.

**Maternal body dissatisfaction.** For brevity, two items were adapted from the Body Change Inventory (BCI) (McCabe & Ricciardelli, 2002) to measure satisfaction with body shape and weight. The items asked respondents “how satisfied are you with your weight” and “how satisfied are you with your body shape?” Self evaluation of weight and shape has been found to be critical in predicting body dissatisfaction accurately (Cash, 1994). Each item was based on a 5-point Likert scale, ranging from 1 – extremely dissatisfied, to 5 – extremely satisfied. The total score for was summed to provide a satisfaction with weight/shape score, with higher scores indicating greater body satisfaction. Scores ranged between 2-10 Cronbach’s alpha for this subscale within the present sample was .91, and the mean inter-item correlation was .83.
State-Trait Anxiety Inventory – Trait Scale [STAI-T] (Spielberger & Reheiser, 2009). A 20-item scale designed to assess frequency of anxiety symptoms and cognitions as a stable personality trait. Items are scored 1-4, and scores range from 20-80, with higher scores indicative of highly frequent and intense symptoms of anxiety. The Trait form was used to examine the impact of more pervasive anxiety symptomology (as a personality trait) on pre-schooler weight outcomes, as opposed to anxiety relating to a particular event or point in time, which the State form measures. In an Australian adult population, a mean of 36.35 (SD = 11.39) has been reported (Crawford et al., 2009). A cut-off of 54 has been specified as indicative of detecting anxiety disorders in a geriatric sample (Kvaal et al., 2005). The scale has shown high test-retest reliability, \( r = .86 \) (Rule & Traver, 1983), good concurrent validity with the Anxiety Sensitivity Index, Anxiety Scale Questionnaire, and the Manifest Anxiety Scale (Spielberger & Reheiser, 2009; Spielberger et al., 1995), and high construct validity. A Cronbach’s alpha of .90 was obtained in the current sample.

Rosenberg Self-Esteem Scale [RSE] (Rosenberg, 1965). A 10-item scale that measures global self-esteem and self-worth. Each item is rated on a 4-point Likert scale ranging from strongly agree to strongly disagree; the total score ranges from 10-30. Norms for Australian adult samples could not be found at time of publication. This scale has shown high internal and test-retest reliability, and good construct validity (Robins et al., 2001). Cronbach’s alpha was .88 in the present study.

Measures of child feeding practices

Child Feeding Questionnaire – Restriction and Pressure subscales [CFQ] (Birch et al., 2001). The CFQ is a questionnaire that examines parent feeding styles, and parental beliefs and concerns about child eating, feeding, and obesity. The Restriction subscale comprises eight items examining parental restriction of child
food intake. The Pressure to Eat subscale included four items that measure parental regulation of child eating. Each item is rated from 1 (disagree) to 5 (agree) and summed to provide a total subscale score. In the current sample, the Restriction subscale yielded a Cronbach’s alpha of .75, and the Pressure to Eat subscale an alpha of .72, suggesting adequate reliability. Feeding practices were measured at study entry only (T1).

**Covariates**

Several demographic variables were measured using a questionnaire developed by the researchers. These were self-reported by the mothers, and measured at T1 only. Based on the results of the systematic review by Benton et al. (2015b), maternal BMI and family income bracket were included in the path model as possible predictors of child BMI-z change. Maternal employment status was also included as a possible predictor, as the results of Benton et al. (2015a) showed that rates of overweight and obesity were significantly higher in children of mothers who were employed, compared to those who were not. Family income was categorised in brackets: under $25,000, $25,001-$45,000, $45,001-$65,000, $65,001-$85,000, $85,001-$105,000, $85,001-$105,000, $105,001-$125,000, $125,001-$145,000, and over $145,001. Employment status was dichotomously measured (yes/no), and maternal BMI was measured as a continuous numerical value. Although the review by Benton et al. (2015b) highlighted maternal age, education, ethnicity, marital and smoking status, and child sex as frequently reported covariates for pre-schooler obesity risk, preliminary correlations and t-tests revealed that these demographic variables were not related to any of the variables of interest in the current sample, thus they were not included in the final path model.

**Preliminary Data Analysis**
The dataset was screened for missing values, internal consistency, and the statistical assumptions of regression. Missing data were estimated using multiple imputation, as this is the gold standard method for treating missing data (Osborne, 2013), and allows analysis of the imputed datasets across multiple applications, including path analysis (Allison, 2003). Using SPSS Statistics 22, 20 imputed datasets were created in accordance with recommendations by Schafer and Graham (2002). The datasets were pooled for statistical analysis. Participants with univariate or multivariate outliers exceeding critical values were deleted ($n = 19$).

**Statistical Analysis**

Pearson’s correlations were undertaken to explore the cross-sectional associations between covariates (maternal BMI, family income, and maternal work status), maternal psychosocial variables (BDI, STAI-T, RSE and BCI scores), maternal feeding practices (maternal Restriction and Pressure scores) and child BMI-z change scores. Correlations were calculated using IBM SPSS Statistics 22, using the pooled estimate function with multiple imputation data.

A path analysis was employed to test the proposed model of maternal psychosocial variables, feeding practices and child BMI-z change (Figure 5.1). The path model was estimated using maximum likelihood estimation in AMOS. Model fit was tested via chi-square goodness-of-fit, comparative fit index: good fit >.95 (Hu & Bentler, 1998); and the root mean square error of approximation: good fit <.06 (Hu & Bentler, 1998). As stated earlier, missing data was dealt with using multiple imputation and as such 20 imputed datasets were created. Given that AMOS is unable to work with pooled multiple imputation data, the path model was run separately for each of the 20 datasets, and results of each separate path analysis were pooled to create an aggregate model. These calculations were computed by hand, in accordance
with Schafer (1997). The model fit was then tested in accordance with guidelines for combining chi-square statistics calculations from Allison (2002). These led to the calculation of a critical value tested against the $F$ distribution, which determined whether the chi-square across imputations was or was not significant, and thus a good fit of the model. For path analysis, the minimum recommended sample size is given by a ratio of 10:1 cases to free parameters in the model (Bentler & Chou, 1987). In the current model, there were 16 degrees of freedom, meaning that a minimum of 160 participants were needed to obtain reliable results. This was well exceeded in the current sample ($N = 279$). The current model yielded a power of .89, based on calculations from Preacher and Coffman (2006).

Independent samples t-tests were also computed to compare child BMI-z change between mothers with elevated scores on each psychosocial measure, and those with normal range scores. Cut-off scores were created using standard deviations from each measure, as published cut-off scores applicable to our population for the scales used did not exist at the time of writing. For the BDI-II, the STAI-T and the RSE, scores two standard deviations from the means were used to indicate elevated (or low range in the case of the RSE and BCI) symptomology. For the BDI, this was $\geq 8.89$, for the STAI-T, $\geq 53.47$, and $\leq 13.08$ for the RSE. As body dissatisfaction was measured using only two items from the BCI, the score range was too small to use the two standard deviation method. Thus, a cut-off of one standard deviation below the mean was used to dichotomise women into normal and elevated body dissatisfaction, which was $\leq 3.5$. Therefore, scores referred to as elevated in the remainder of the paper are defined as two standard deviations from the sample mean for depressive and anxiety symptoms, and self-esteem, and one standard deviation for the sample mean for body dissatisfaction.
Results

Participant Characteristics

Demographic information is presented in Table 5.1. The mean maternal age was 35.8 ($SD = 4.2$) years, and the majority of participants were born in Australia or New Zealand (84.4%) and married (95.9%). Just over half of the mothers were currently employed, the majority were tertiary educated, and the most commonly reported income bracket was $85,001 - $105,000 AUD; 43% did not provide either child weight or height data at T2. Mothers who did not complete T2 outcome measures were not significantly different to completers on demographic variables, feeding practices, depressive and anxiety symptoms, or self-esteem. Independent t-tests, however, revealed significant differences in body dissatisfaction between the groups, with completers showing higher body satisfaction ($M = 6.02$, $SD = 2.22$) than non-completers ($M = 5.29$, $SD = 2.36$), $t(277) = -2.445$, $p = .015$, two-tailed.

Half the mothers’ BMIs (51%) fell within normal range (BMI 18.5-24.9); 35% were in the overweight range (BMI 25-29.9), and an additional 12.5% in the obese range (BMI 30+). Children had a mean age of 2.9 years ($SD = .75$) at T1, 5.3 years ($SD = 1.2$) at T2, and just under half were male (43.9%). At T1, child BMI-z ranged from -5.91 to 3.23 ($M = -.04$, $SD =1.3$). The majority of children fell within the healthy weight BMI category (72.1%); 12.2% were categorised as overweight and a further 2.4% as obese. At T2, child BMI ranged from -3.26 to 4.78 ($M = .26$, $SD =1.16$). The majority of children were again healthy weight (68.8%), however this was slightly lower compared to T1 (72.1%). The prevalence of overweight children was 13.1%, a marginal increase from over the 24 month period (T1: 12.2%; T2: 13.1%), however, the prevalence of pre-schooler obesity remained around the same (T1: 2.4%; T2: 2.0%).
The prevalence of poor maternal psychosocial health was low across all four measures: 5.5% for the BDI, 3.5% for the STAI, and 2.4% for the RSE (Table 5.2). Maternal body dissatisfaction yielded the highest percentage of participants scoring below the specified cut-off (15.9%).
Table 5.1.
**Participant demographic characteristics**

<table>
<thead>
<tr>
<th>Variable</th>
<th>T1</th>
<th>T2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean maternal age</td>
<td>35.8 (SD = 4.2)</td>
<td>38.4 (SD = 3.8)</td>
</tr>
<tr>
<td>Mean maternal BMI (kg/m²)</td>
<td>25.3 (SD = 4.5)</td>
<td>25.5 (SD = 5.1)</td>
</tr>
<tr>
<td>Maternal marital status, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/de facto</td>
<td>95.9 (N = 275)</td>
<td></td>
</tr>
<tr>
<td>Divorced/separated/widowed/never married</td>
<td>4.1 (N = 12)</td>
<td></td>
</tr>
<tr>
<td>Maternal marital status, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family income ≥ $85 001 AUD</td>
<td>63.9 (N = 185)</td>
<td></td>
</tr>
<tr>
<td>Maternal education ≥ bachelor degree</td>
<td>66.9 (N = 192)</td>
<td></td>
</tr>
<tr>
<td>Maternal current employment</td>
<td>56.1 (N = 161)</td>
<td></td>
</tr>
<tr>
<td>Maternal country of birth, %</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>Australia or New Zealand</td>
<td>84.4 (N = 242)</td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td>8.4 (N = 24)</td>
<td></td>
</tr>
<tr>
<td>Asia</td>
<td>2.8 (N = 8)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>4.4 (N = 13)</td>
<td></td>
</tr>
<tr>
<td>Mean child age, years</td>
<td>2.9 (SD = .7)</td>
<td>5.3 (SD = 1.2)</td>
</tr>
<tr>
<td>Male children, %</td>
<td>43.9 (N = 126)</td>
<td>N/A</td>
</tr>
<tr>
<td>Child weight variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean child weight, kg</td>
<td>14.89 (SD = 2.6)</td>
<td>20.1 (SD = 3.9)</td>
</tr>
<tr>
<td>Mean child BMI, kg/m²</td>
<td>16.2 (SD = 1.6)</td>
<td>15.82 (SD = 1.8)</td>
</tr>
<tr>
<td>Mean child BMI-z score</td>
<td>-0.04 (SD = 1.3)</td>
<td>0.28 (SD = 1.1)</td>
</tr>
<tr>
<td>Child BMI categories, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>13.2</td>
<td>11.6</td>
</tr>
<tr>
<td>Healthy</td>
<td>72.1</td>
<td>68.8</td>
</tr>
<tr>
<td>Overweight</td>
<td>12.2</td>
<td>13.1</td>
</tr>
<tr>
<td>Obese</td>
<td>2.4</td>
<td>2.0</td>
</tr>
</tbody>
</table>

BMI, body mass index; BMIz, body mass index z-score; SES, socio-economic status; child BMI based on WHO Child Growth Standards for pre-schoolers (De Onis & Lobstein, 2010).

Table 5.2.
**Means, standard deviation and percentages of elevated scores for maternal psychosocial variables**

<table>
<thead>
<tr>
<th></th>
<th>BDI</th>
<th>STAI-T</th>
<th>RSE (SD)</th>
<th>BCI (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD)</td>
<td>3.32</td>
<td>36.35</td>
<td>22.72 (4.82)</td>
<td>5.75 (2.28)</td>
</tr>
<tr>
<td>% elevated</td>
<td>5.5</td>
<td>3.5</td>
<td>2.4</td>
<td>15.9</td>
</tr>
<tr>
<td>Observed range of scores</td>
<td>0-25</td>
<td>20-37</td>
<td>11-30</td>
<td>2-10</td>
</tr>
<tr>
<td>Possible range of scores</td>
<td>0-39</td>
<td>20-80</td>
<td>0-30</td>
<td>2-10</td>
</tr>
</tbody>
</table>

BDI – Beck Depression Inventory; STAI-T – State-Trait Anxiety Inventory, Trait Scale; RSE – Rosenberg Self-Esteem Scale; BCI - Body Change Inventory
Bivariate Correlations

Several significant correlations were present between the variables within the path model (Table 3). Child BMI-z change scores from T1 to T2 were not significantly correlated with any of the variables in the model.

Table 5.3.
Bivariate correlations between variables in the path model

<table>
<thead>
<tr>
<th>Variable</th>
<th>BDI T1</th>
<th>RSE T1</th>
<th>STAI T1</th>
<th>BCQ T1</th>
<th>CFQ Restriction T1</th>
<th>CFQ Pressure T1</th>
<th>Mother BMI T1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child BMI-z change score (T2 - T1)</td>
<td>0.03</td>
<td>0.03</td>
<td>0.08</td>
<td>0.01</td>
<td>-0.02</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>BDI T1</td>
<td>-.27**</td>
<td>.70**</td>
<td>-.44**</td>
<td>-.01</td>
<td>0.08</td>
<td>.14*</td>
<td></td>
</tr>
<tr>
<td>RSE T1</td>
<td>-.33**</td>
<td>.17**</td>
<td>-.04</td>
<td>0.04</td>
<td>-0.02</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>STAI T1</td>
<td>-.31**</td>
<td>0.10</td>
<td>0.12</td>
<td>-0.11</td>
<td>-.55**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BCQ T1</td>
<td>0.08</td>
<td>-0.03</td>
<td>-0.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFQ Restriction T1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFQ Pressure T1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother BMI T1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Model Fit

Results of the path analysis revealed inadequate fit of the data ($\chi^2 = 121.55(18), p < .01$, comparative fit index = .744, root mean square error of approximation = .000). Modification indices suggested the inclusion of a direct pathway between family income and child BMI-z change would improve model fit. This pathway is theoretically and empirically supported, as income has been associated with child weight outcomes in the literature (Danielzik, Czerwinski-Mast, Langnäse, Dilba, & Müller, 2004; Vieweg, Johnston, Lanier, Fernandez, & Pandurangi, 2007; Wang & Zhang, 2006), and fits within the proposed
ecological model of child obesity (Harrison et al., 2011). The respecified model revealed an adequate fit of the data ($\chi^2 = 13.44(14), p > .05$, comparative fit index = .999, standardised root mean error of approximation = .017). The significant paths are shown in Figure 2. Family Income at T1 was the only significant predictor of child BMIz change at T2. Mother BMI at T1 was a significant positive predictor of BDI scores, and a significant negative predictor of body satisfaction scores, and there was a significant negative pathway between depressive symptoms and body satisfaction scores. There was a significant negative pathway between anxiety and self-esteem scores, and anxiety symptoms were a significant positive predictor of restrictive feeding. All other pathways were not statistically significant.
Figure 5.2. Final path model of maternal psychosocial indices, feeding practices and child BMI-z change with standardised path coefficients. *p < .05 ** p < .001; significant results are also denoted in bold.
Comparisons of Child BMI-z Change Between Mothers Scoring Within and Beyond Cut-offs on Psychosocial Measures

Independent t-tests were conducted to compare differences in child BMI-z changes between mothers who scores beyond cut-offs on the psychosocial measures, and mothers who did not. Results revealed no significant group differences in child BMI-z change for any of the maternal psychosocial measures; all $p > .05$ (Table 4). As no mothers scored beyond the cut-off for self-esteem, t-tests for this measure could not be run.

Table 5.4. Independent t-tests comparing child BMI-z change scores between mothers scoring within and beyond cut-offs on the psychosocial measures

<table>
<thead>
<tr>
<th></th>
<th>$t$</th>
<th>$df$</th>
<th>$p$</th>
<th>Mean(SD) BMI-z change – mothers within cut-off</th>
<th>Mean(SD) BMI-z change – mothers beyond cut-off</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDI</td>
<td>-0.77</td>
<td>274</td>
<td>.44</td>
<td>.29 (1.17)</td>
<td>-.17 (3.3)</td>
</tr>
<tr>
<td>STAI</td>
<td>-0.57</td>
<td>274</td>
<td>.57</td>
<td>.29 (1.73)</td>
<td>-.14 (2.68)</td>
</tr>
<tr>
<td>BCQ</td>
<td>0.05</td>
<td>274</td>
<td>.96</td>
<td>.28 (1.7)</td>
<td>.29 (2.13)</td>
</tr>
</tbody>
</table>

Discussion

The underpinnings of child obesity are multifactorial. Unhealthy diet and sedentary behaviours are widely established causes of pre-schooler obesity, however various other aspects have been illuminated in research, including genetics, socio-economic status, ethnicity, and parental weight status, eating behaviours and lifestyle attitudes (Batch & Baur, 2005). The influence of parental factors over child obesity are seen as pivotal in the research field, and within this, maternal mental health is now also gaining momentum as a crucial risk factor. It is critical that we understand the factors that increase the risks of obesity developing during the pre-school years, as
this is a critical period for eating and activity development in which lifelong patterns may be formed (Birch & Fisher, 1998a; Dowda et al., 2003), and overweight/obesity during this time increases the risk of chronicity, rendering individuals more likely to maintain their overweight/obese status into adulthood (Cole, 2004b; Williams & Goulding, 2008a). While many studies have demonstrated clear links between maternal depressive symptoms and increased risks for pre-schooler obesity (Benton et al., 2015b), other indices of maternal mental health have been largely overlooked, such as anxiety and body dissatisfaction, even though research suggests these may play an important role (Guxens et al., 2013; Rodgers et al., 2013; Benton et al., 2015a). Additionally, although it has been well documented that negative maternal child feeding practices increase the risk of obesity in pre-schoolers (Blissett & Haycraft, 2008; Blissett, Meyer, & Haycraft, 2006; McPhie et al., 2012b), there is also a paucity of research examining whether maternal psychosocial indices other than depressive symptoms influence feeding practices (Benton et al., 2015b).

The primary aim of the present study was to examine whether maternal psychosocial indices predicted pre-schooler BMI change over two years, via maladaptive feeding practices. A path model was employed to examine whether these variables, along with demographic variables known to influence pre-schooler BMI (maternal BMI, family income and maternal work status), predicted a change in child BMI z-scores from approximately age 3 to 5 years. Results of the path analysis revealed that only family income significantly predicted pre-schooler BMI-z change; none of maternal psychosocial indices or maternal child feeding practices predicted child BMI-z score change at follow-up. Maternal anxiety symptoms were the only predictor of restrictive feeding practices; no other variables predicted restrictive or pressure feeding. The secondary aim of the study was to compare BMI-z change
scores in children of mothers with elevations on the psychosocial measures, and mothers without elevations. Independent t-tests revealed no differences in child BMI-
\[ z \] change between children of mothers scoring within and beyond cut-offs on the psychosocial measures.

The latter findings are somewhat inconsistent with the cross-sectional study in this sample (Benton et al., 2015a), which found that pre-schoolers of mothers scoring beyond cut-offs on the body dissatisfaction measure had significantly higher BMI-z scores. This may suggest that whilst maternal body dissatisfaction may relate to pre-schooler weight when measured concurrently, the relationship does not persevere as the child grows older into the later pre-school years. Taking concurrent measures of the maternal psychosocial variables at two-year follow-up may have been useful to determine whether the relationship is present if maternal body dissatisfaction is elevated in the later pre-school years. However, the cross-sectional study did note that effect sizes were small, and as the t-tests did not control for covariates, it is possible that this study did not represent a true group difference in the BMI-z of children between mothers with and without heightened body dissatisfaction.

In the present study, maternal depressive symptoms were not related to child BMI-z change. This is inconsistent with the vast majority of previous literature (Benton et al., 2015b), however, is consistent with some studies (Duarte et al., 2012; Phelan et al., 2011; Wojcicki et al., 2011). These studies also reported small percentages (<10%) of mothers displaying elevated depressive symptomology, thus, results may be based on a restricted range of mothers experiencing elevated depressive symptoms. Therefore the power to detect a significant effect may not have been tenable with such small numbers of mothers experiencing significant depressive symptomology. Maternal self-esteem was unrelated to both maternal feeding and pre-
schooler BMI-z change. Maternal feeding practices were also unrelated to pre-
schooler weight outcomes, which is inconsistent with previous literature that has
reported restriction to be associated child obesity risk (Faith et al., 2004b; Faith &
Kerns, 2005; Ventura & Birch, 2008). It may be the case however, that such
associations do not present until children are older. Rodgers et al. (2013) reported that
restrictive feeding did not predict pre-schooler BMI-z change over a two year period.
Faith et al. (2004b) found that restriction at child age 5 predicted higher weight at
child age 7, while other studies have focused on the influence of restriction on eating
in the absence of hunger (Birch et al., 2003a), and greater preference for restricted
foods (Fisher & Birch, 1999b). The current study did not examine these facets of
obesity risk, and focused on a younger population, thus possibly explaining the null
findings between restrictive feeding and pre-schooler weight outcomes. Pressure to
eat, on the other hand, has been associated with decreased child obesity risk (Faith et
al., 2004b; Ventura & Birch, 2008). However, Campbell et al. (2006) found that
pressure significantly predicted higher energy intake, higher savoury and sweet snack
cconsumption, and higher energy drink consumption in 5-6 year olds. McPhie et al.
(2012b) also reported that maternal pressure to eat predicted greater child weight gain
over a 12 month period in pre-schoolers. Thus, it is possible that pressure impacts on
obesity risk factors other than BMI-z, such as food intake, that were not measured in
the current study, and thus potential associations between pressure and obesity risk in
general were not detected. It is also possible that as with restriction, a longer follow-
up period, into later childhood, is needed to illustrate such relationships; that is, early
pressure to eat may lead to child obesity at older ages.

The finding that higher family income significantly predicted greater increases
in child BMI-z scores from T1 to T2 is unusual, as there is a strong body of evidence
to suggest that child overweight and obesity is associated with lower socioeconomic status (Bammann et al., 2013; Danielzik et al., 2004; Vieweg et al., 2007). In general, families with higher SES tend to have greater access to fresh and healthier foods, and better health knowledge of nutrition and food preparation, thus obesity risk is reduced (Janssen, Boyce, Simpson, & Pickett, 2006). However, the Ecological Obesity Framework (He, James, Merli, & Zheng, 2014) suggests that while an individual may possess high health knowledge, this may not be strong enough to overpower environmental triggers that fuel obesity promoting behaviours, such as hedonic eating and sedentary behaviours. Wang and Zheng (2006) also suggest that whilst higher SES groups have greater access to healthy foods, they also have greater access to computers, gaming consoles and smartphones, tablets, etc., which encourage sedentary behaviours. Given that variables relating to nutritional knowledge, access to healthy food and sedentary behaviours were not assessed in the current study, it is not possible to examine the relationship between such factors, family income and child obesity.

Another possibility is that maternal employment status had an indirect effect on child weight outcomes. In the current study maternal employment and family income had a significant correlation, and research has shown that families with working mothers are less likely to have structured meal times, or rules about eating as a family or TV viewing, which are risks for child overweight and obesity (Anderson, Butcher, & Levine, 2003). Additional research has also shown that working mothers spend less time cooking and eating with their children, and are more likely to purchase packaged foods (Cawley & Liu, 2012). Although maternal employment was not a significant predictor of child BMI-z change in the model, it was a significant predictor of child BMI-z at T1 in the cross-sectional study of the same sample.
It must be kept in mind however, that given the homogeneity of the current samples’ socioeconomic profile, results cannot necessarily be generalised to other research using more heterogeneous samples with regard to income, employment, education, and so forth.

The relationship between maternal anxiety and restrictive feeding practices identified in the path model is consistent with previous research (Blissett & Farrow, 2007; Farrow & Blissett, 2006; Haycraft & Blissett, 2008a; Hurley et al., 2008a; Ystrom et al., 2012a). These relationships have been demonstrated during child infancy (Blissett & Farrow, 2007; Farrow & Blissett, 2006; Hurley et al., 2008a), and the pre-school years (Haycraft & Blissett, 2008a; Ystrom et al., 2012a). Haycraft and Blissett (2008a) reported that maternal anxiety was associated with increased control over child’s eating and decreased sensitivity to child’s hunger-fullness cues. Hurley et al. (2008a) found that maternal anxiety predicted higher restrictive feeding styles, as well as forceful and uninvolved feeding styles; they also used the STAI to measure maternal anxiety. Ystrom et al. (2012a) measured maternal anxiety via a construct of negative affect, which included depressive and anxiety symptoms, hostility and anger, and self-esteem, and reported that higher negative affect was associated with greater restriction and pressure feeding practices. Several explanations have been offered for this relationship: mothers’ anxiety may be relieved by asserting control over an external situation, such as child food intake (Hurley et al., 2008a), mothers’ anxiety may prevent correct interpretation of child hunger-fullness cues, leading to greater control over child diet through restriction (Farrow & Blissett, 2006), or mothers’ anxiety may be related to societal ideals of weight and shape, which may fuel restriction to prevent their child from becoming overweight/obese. Paradoxically though, restrictive feeding practices have been linked consistently to an increased risk
of child overweight and obesity (Faith & Kerns, 2005). Thus, it may be useful to
determine the role maternal anxiety plays in promoting restrictive feeding practices to
aid in the prevention of child overweight and obesity.

The current study has several limitations that must be noted. Independent t-tests
revealed that mothers who did not provide child weight and height data at T2 had
significantly lower body satisfaction at T1, compared to mothers who did complete
T2 data. Given that the initial cross-sectional study (Benton et al., 2015a) found that
mothers with lower body satisfaction had children with significantly higher BMI-z
score, it may also be the case that overweight and obese children were lost to follow-
up, limiting this population within our sample. Strong attempts were made, however,
to account for missing data through the use of multiple imputation to estimate missing
data. Furthermore, there were no differences in baseline depressive and anxiety
symptoms, or self-esteem, in mothers who did and did not complete the follow-up at
T2.

Furthermore, there was a low percentage of women reporting scores exceeding the
cut-offs on the psychosocial indices, and low prevalence of child overweight and
obesity, potentially leading to a restricted range of scores. The percentages of child
overweight and obesity within our sample were also notably lower than nationally
representative data (Australian Bureau of Statistics, 2013a), thus suggesting our
sample is not nationally representative with regard to child weight status. The
prevalence of peri-natal depression (0-24 months from birth) has been reported to be
approximately 20% in a nationally representative Australian sample (Australian
Institute of Health and Welfare, 2012), whilst in the current sample, only 5.5%
reported depressive symptoms. Research has also shown that all participants of an
Australian female sample reported body dissatisfaction (Tiggemann & Lynch, 2001),
whilst body dissatisfaction was only high in 15% of the current sample. Future research should aim to sample widely to ensure the prevalence of maternal depressive and anxiety symptoms, body dissatisfaction, and child overweight and obesity are equivalent to national statistics.

Our sample was demographically homogeneous, with the majority of the sample born in Australia, married or de facto, moderate to high income, and tertiary educated. Based on the most recent Australian statistics, the majority of the present sample reported an annual family income (> $85,001) between the moderate ($41,236) and high annual income brackets (> $94,328), after tax (Australian Bureau of Statistics, 2013b). As participants were not asked to indicate whether their income was before or after tax, it is possible that the average income was higher than reported in the present sample. The rates of maternal employment in the current sample (56.1%) were similar to the most recently reported Australian population rates (57%) (Baxter, 2013). With regard to marital status, the percentage of married and de facto mothers in the current sample (95.9%) well surpassed the Australian norms (64%) (Australian Bureau of Statistics, 2013c). The percentages of mothers in the current who were tertiary educated (66.6%) was also notably higher than the most recent Australian statistics (40%) (OECD, 2011). Furthermore, country of birth rather than ethnicity was measured. Therefore, our results cannot be generalised to other nationalities or ethnicities, or to lower socio-economic samples. As mentioned above, the high SES characteristics of the current sample, along with the low prevalence of poor maternal psychosocial health and child obesity may account for the null findings between the maternal psychosocial indices, feeding practices and child overweight and obesity. It should also be noted that the results of the current study were based on a convenience sample who volunteered their participation, and that the response rate for surveys
mailed out was 56%. Previous research has noted participation bias in favour of those with higher SES and educational attainment (Lissner et al., 2003). This may explain the homogeneity of the current sample with regard to demographic variables.

In the current study child BMI-z scores were only measured as an outcome of obesity risk, rather than accounting for a broad range of variables related to child obesity, such as physical activity (Fernald et al., 2008; Tremblay, Lysin, Zecevic, & Larivière, 2011), diet and nutrition (Millar et al., 2014), and sedentary behaviours (Burdette et al., 2003; Mistry et al., 2007). Future studies should aim to measure a variety of risk factors for child obesity, rather than examining weight-related variables in isolation, as taken together these may be more indicative of the risk for developing obesity at older ages. As discussed above, it is also possible that certain predictors of pre-schooler obesity risk interact with nutrition and eating variables more so than weight outcomes specifically, thus other measures of obesity risk must be taken into account. Furthermore, all data were self-reported by mothers, which may have led to inaccuracies in responding due to the subjective nature of self-report. Although the correlation between observed and maternal reported child BMI data was moderate, previous research has demonstrated that whilst inaccuracies in parental reports of height and weight data for pre-schoolers exist, they were not significantly different to independent measurement (O'Connor & Gugenheim, 2011). Research has demonstrated the importance of employing objective, observational methods to examine the complex, bi-directional relationship between maternal and child interactions in relation to feeding and weight-related variables (Demir et al., 2012). Future research should also consider the use of more objective, observational methods of these variables if possible. While the current study was longitudinal, a longer follow-up period may have been beneficial to determine whether maternal influences
during the pre-school years impact on child obesity later in childhood and adolescence.

Building on previous research, the current study is the first to prospectively examine the relationships between maternal psychosocial indices, feeding practices, and weight outcomes in pre-school aged children. Although the results were non-significant, the paper makes a meaningful contribution to the current literature by firstly addressing the current gap in the literature by considering the impact of maternal psychosocial indices such as anxiety, body dissatisfaction and self-esteem on pre-schooler obesity risk. It is important that this gap be addressed in accordance with ecological models of child obesity, where the identification of parental influences over child obesity risk are crucial in discerning methods of intervention and prevention. The current study revealed that within a path model, maternal psychosocial variables and child feeding practices did not predict increases in pre-schooler BMI-z scores between the ages 2-5. Future research should aim to examine these relationships within a broader socioeconomic sample, fostering comparisons between groups of demographically diverse mothers. Identifying key causal factors of pre-schooler obesity is crucial in the prevention and intervention of overweight and obesity.
References


Chapter Six

General Discussion

The need to address the ever-increasing childhood obesity epidemic is now recognized worldwide (World Health Organisation, 2015), with prevention and intervention efforts widespread (Luttikhuis et al., 2009; Waters et al., 2012). Research has shown that children who are overweight or obese are more likely to maintain this weight status into adulthood (Ferraro et al., 2003), leading to even higher levels of overweight and obesity in the population. Given the major physical (Ali et al., 2010; Inge et al., 2007; Steinbeck, 2010) and psychosocial (Inge et al., 2007; Mills & Andrianopoulos, 1993; Power et al., 1997) health consequences of overweight and child obesity, it is imperative that research informs the optimal methods for addressing this health condition in children. While intervention research is highly prevalent in child populations (Luttikhuis et al., 2009), prevention is key to tackling the issue head on, and commencing this at an early age is also imperative. The preschool years in particular have been identified as a critical period for the development of obesity in later childhood and adulthood (Rolland-Cachera et al., 2006; Williams & Goulding, 2008a). Parents are seen to play a key role in the development of obesity in their offspring during the pre-school years, prior to wider influences from the community once the child commences schooling. Child feeding practices have been heavily researched as risk factors for pre-schooler obesity, and in particular, mothers’ feeding practices. Unhealthy feeding practices, including restriction (Faith et al., 2004b) and pressure to eat (McPhie et al., 2012b) have been associated with pre-schooler overweight and obesity. Maternal psychopathology has also been linked to the use of unhealthy child feeding practices (Blissett & Haycraft, 2008; Duke et al., 2004; Haycraft & Blissett, 2008a; Hurley et al., 2008a; Tiggemann & Lowes, 2002b;
Ystrom et al., 2012a), and the influence of maternal psychopathology over pre-schoolers’ obesity risk is also gaining attention (Benton et al., 2015b).

The aim of the first study of the present thesis was to systematically review the existing literature that examined the relationship between maternal psychopathology and obesity risks in pre-schoolers exclusively. The findings of the review identified current gaps in the literature, which, in addition to theoretical models, guided the subsequent two empirical studies of this thesis. The findings also revealed that research to date has focused predominantly on maternal depressive symptoms, while other indices of psychological wellbeing, such as anxiety, self-esteem and body satisfaction have been neglected. Furthermore, although the review did not include maternal feeding practices, as this has been addressed in prior work (McPhie et al., 2012a), no studies have examined the relationship between maternal psychopathology, unhealthy feeding practices, and pre-schooler obesity risk in one comprehensive model. Therefore, the overall aim of the empirical studies within the current thesis was to address this gap by creating a model that tested whether maternal psychopathology and unhealthy maternal feeding practices predicted pre-schooler obesity risk.

Study findings

The systematic review included 20 papers, and reported that two thirds of these studies revealed positive associations between maternal depressive symptoms and pre-schooler obesity risks. Two single papers identified relationships between maternal anxiety and body dissatisfaction with pre-schooler obesity, and increased BMI-z change over a two-year period, respectively (Guxens et al., 2013; Rodgers et al., 2013). Maternal self-esteem was not measured in any of the reviewed studies. The relationship between maternal depressive symptoms and pre-schooler obesity
remained significant after covariate adjustment in just over half the studies. The most frequently included covariates were maternal education, marital status, age, ethnicity, BMI, family income, child sex and maternal smoking status. There was a minority of studies that found relationships attenuated to non-significance after covariate adjustment (covariates in these studies included maternal age, marital status, smoking status and child sex). There were mixed results according to child age, with some finding no associations between maternal psychopathology and obesity risk in children younger than 24 months, whilst others reported relationships in children as young as six months. Results were similar at older ages, with studies finding no relationships between maternal psychopathology and obesity risk in 4-year-old children, whilst others reported relationships in children aged 3 years. Specific to the studies examining maternal depressive symptoms, results also varied according to the time at which this variable was measured. Some studies noted significant relationships when symptoms were measured prenatally, but others reported non-significant results. This was also true for post-natal measurement, with some studies finding significant relationships and others no relationship. Results from the studies that measured maternal depressive symptoms both pre- and postnatal were also mixed. It was concluded that further research is needed to establish whether maternal psychopathology, particularly under-researched variables such as anxiety, body dissatisfaction and self-esteem, are associated with increased pre-schooler obesity risk. It was also suggested that recruiting samples with an adequate prevalence of elevated maternal psychopathology, and controlling for demographic covariates, would strengthen future research.

The first empirical study (Chapter Four) of the current thesis was a cross-sectional design, and used hierarchical regression to explore the relationships between
maternal depressive and anxiety symptoms, self-esteem, body dissatisfaction, maternal use of restriction and pressure to eat feeding practices, and pre-schooler BMI-z scores, as a measure of obesity risk. This study was conducted when children were approximately age 24-36 months. The second empirical study (Chapter Five) replicated the first, however, employed a prospective longitudinal design. Using a path model, the second study tested whether the maternal psychosocial measures employed in the first study predicted unhealthy feeding practices, and whether these in turn predicted increases in child BMI-z scores at 24-month follow-up (pre-schoolers were aged approximately 60 months).

The first empirical study revealed that cross-sectionally, none of the maternal psychosocial measures or feeding practices were related to pre-schooler BMI-z scores in the regression model; only maternal BMI and maternal employment were significantly and positively related to BMI-z scores. Similar to the first, the second empirical study reported that none of the maternal psychopathology measures, nor feeding practices, predicted pre-schooler BMI-z change scores in the final path model. Family income was the only significant predictor of child BMI-z change. Independent t-tests revealed no significant differences in child BMI-z change between children of mothers scoring within the psychosocial measure cut-offs, and those scoring beyond the cut-offs.

The finding that child BMI-z change was no different between mothers with and without elevated body dissatisfaction in the second empirical study was inconsistent with the results of the first study. The cross-sectional t-tests, which found mothers with elevated body dissatisfaction had children with significantly higher BMI-z scores, were however, consistent with the work of Rodgers et al. (2013), the only other known study that measured maternal body dissatisfaction in relation to pre-
schooler obesity. Rodgers et al. reported that maternal body dissatisfaction significantly predicted maternal dietary restraint, which predicted a significant increase in pre-schoolers’ BMI-z over two years. The association between parental dietary restraint and increased child obesity risk has been demonstrated previously (Francis & Birch, 2005a; Hirsch et al., 2014; Hood et al., 2000). Francis and Birch (2005) noted that mothers’ dietary restriction led to daughters’ dietary restriction, and Hirsch et al. (2014) found that restrained eating was associated with overweight in children. Taken together these findings reveal that mothers’ body dissatisfaction appears to lead to their own dietary restraint, which appears to be associated with an increased risk for weight gain in children. As dietary restraint was not measured within the current thesis, future research should consider the influence of this variable on the relationship between maternal body dissatisfaction and pre-schooler BMI-z change.

No relationship between maternal anxiety and child BMI-z was found in either of the empirical studies. The only study that examined maternal anxiety yielded in the systematic literature review presented in Chapter Two (Benton et al., 2015b) found that pre-schooler obesity in a sample of 4-year-olds was predicted by pre-natal anxiety symptoms (Guxens et al., 2013). Conversely, maternal anxiety was measured when the child was approximately three years old in the current thesis. The percentage of mothers experiencing anxiety symptoms was notably higher in Guxens et al.’s sample (10.4%) compared to the present sample (3.5%), thus the restricted range in the current thesis may have led to null findings. However, different measures of anxiety were used between the two studies, thus it is difficult to compare results. The relationship between maternal depressive symptoms and pre-schooler obesity was also non-significant in both empirical studies. In the present thesis, maternal
depressive symptoms were measured only once, when children were aged approximately 24-36 months. As discussed in previous chapters, chronic depression (i.e., presence of symptoms across several measurement points) may be a stronger predictor of pre-schooler obesity than depressive episodes (i.e., measured at single time points) (Santos et al., 2010a; Wang et al., 2013a). Another factor to consider is the low prevalence of depressive symptoms within the current sample. Previous studies that have also found null associations between maternal depressive symptoms and pre-schooler obesity risks have also consisted of small percentages of mothers with elevated depressive symptoms (Duarte et al., 2012; Phelan et al., 2011; Wojcicki et al., 2011). Furthermore, the studies examined in the systematic review paper (Chapter Two) that supported a link between maternal depressive symptoms and pre-schooler obesity reported a higher prevalence of elevated maternal depressive symptomology than the current study, that were more consistent with national prevalence rates of their samples. Therefore, as the analyses were based on a restricted range of scores for maternal depressive symptoms, it is likely that they do not accurately depict the relationship between elevated maternal depressive symptoms and child BMI-z scores. The systematic review in Chapter Two highlighted the need for adequate percentages of mothers with elevated scores on the psychosocial measures within study samples to increase statistical power to detect an effect. Unfortunately, this was not the case with the current sample, as the prevalence of elevated depressive symptoms was one quarter of nationally reported statistics (Australian Institute of Health and Welfare, 2012).

The null relationship between maternal self-esteem and pre-schooler BMI-z is the first, to the authors’ knowledge, to be reported between these variables, as no other studies have examined maternal self-esteem in the context of pre-schooler
obesity risk. In older children (6-13 years), Gibson et al. (2007a) found that mothers’ scores on the Rosenberg Self Esteem Scale, the same used in the present thesis, were not predictive of child BMI-z scores in a regression model. Mehta, Siega-Riz, Herring, Adait and Bentley (2011) also found that maternal self-esteem did not predict failure to initiate breast-feeding (a risk for child obesity). Thus, based on the results of previous and the current empirical studies, it appears that self-esteem may not be a risk factor for child or pre-schooler obesity.

The lack of association between feeding practices and pre-schooler BMI-z was unexpected, as there is a strong body of evidence supporting associations between maternal use of restriction and child obesity risk (Clark et al., 2007; Faith & Kerns, 2005; Ventura & Birch, 2008), and also between pressure to eat and decreased child obesity risk (Francis et al., 2001; Spruijt-Metz, Lindquist, Birch, Fisher, & Goran, 2002a; Ventura & Birch, 2008). However, the majority of these studies included children beyond the pre-school years. Furthermore, several studies with exclusively pre-schooler samples have reported no relationships between restriction/pressure and child BMI (Gemmil et al., 2013; Gregory et al., 2010; Rodgers et al., 2013), and other longitudinal studies have found that restriction and pressure were unrelated to pre-schooler obesity, however were related to obesity in later childhood (Birch et al., 2003a; Webber et al., 2010b). The use of restriction and pressure were also quite high in the present sample, suggesting that power to detect a relationship was sufficient, albeit not revealed. Therefore, taken together with these findings from previous studies, it is possible that the direct relationship between pressure/restriction and child obesity is not as strong during the early pre-school years, however is likely to be developing at this time, and thus should be studied over longer periods across childhood.
The relationship between pre-schooler obesity risk and covariates varied between the two empirical studies; in the first, maternal BMI and employment were related to child BMI-z, whilst in the second, family income was the only significant predictor of child BMI-z change. The relationship between maternal BMI and child BMI-z scores has been well documented (Lean, 2010; Whitaker et al., 2010), however it is interesting that this relationship was not present longitudinally. The finding that family income predicted increases in child BMI-z change longitudinally is unusual, albeit it is consistent with the cross-sectional relationship between maternal employment and child BMI-z in Study One, as work status and income were correlated. As discussed in previous chapters, it is thought that maternal employment may leave mothers with less time to prepare healthy meals for their children (Cawley & Liu, 2012), and higher incomes provide access to computers and gaming consoles which promote sedentary activity (Wang & Zhang, 2006). As nutrition and sedentary behaviour were not measured in the current thesis, it is not possible to determine whether these factors explain the associations between the covariates and child BMI-z. Furthermore, the change in relationship between these socioeconomic factors and child BMI-z scores across the two empirical studies warrants further research to determine the mechanisms by which they influence pre-schooler obesity risk.

**Theoretical Implications**

The results of the current thesis can be conceptualised using the developmental ecological framework developed by Harrison et al. (2011). The model comprises six layers that are proposed to influence child obesity risk (see p. 8). The current thesis was concerned primarily with the Personal and Relational Attributes zone of the Clan layer, which includes maternal mental health and demographics such as parental BMI and family income, and the Nutrition-Related Practices zone of the
Clan layer, which acknowledges maternal child feeding practices. The model highlights how incredibly complex the relationship is between the child itself and its interaction with its environment in conceiving obesity risks, and acknowledges that there are bidirectional relationships between each layer. Furthermore, Harrison et al.’s ecological model posits that children are more heavily influenced by the proximal layers (i.e., first three) at younger ages (infancy to through to school-age) before they become more frequently exposed to peers and the wider community. Interestingly, using a similar ecological systems theory of obesity (Brofenbrenner, 1992), Boonpleng et al. (2013) found that family characteristics accounted for 71% of the variance in pre-schooler overweight/obesity, whilst factors at the school (kindergarten) level explained 27% and community factors explained only 2%. These results were longitudinal, with children followed from age 9 months to kindergarten entry. Family characteristics that were measured in this study included parental education, ethnicity, income, maternal work status and BMI, maternal weight gain during pregnancy, breastfeeding, and age at solid food introduction. The findings of Bloonpleng et al.’s study demonstrated the significance of familial influences on preschoolers weight status, and together with Harrison et al.’s model, highlight the importance of considering the influence of mothers’ psychosocial health on preschoolers’ obesity risks. The current thesis is consistent with Harrison et al.’s model, as children of mothers with elevated body dissatisfaction, anxiety and depressive symptoms were more likely to be overweight or obese. Maternal anxiety was also related positively to restrictive feeding, however feeding practices did not predict child obesity risk, measured as child BMI-z scores. The specific mechanisms by which maternal psychosocial health may impact on pre-schooler weight are less discussed in Harrison et al.’s model, however other theoretical models may shed light
A systems perspective theoretical model proposed by Wachs (2008) was designed to explain nutritional deficiencies in children, as a risk for both obesity and under-nutrition. It borrows from the UNICEF extended care model, which specifies food economic resources, caregiver resources and community resources as the pillars of child nutrition. Wachs extends on the UNICEF theoretical model by adding to it specific maternal resources, which comprise: education, intelligence and depression. Intelligence is defined here as the mothers’ adaptability to her environment. It also accounts for child factors, such as temperament, age, sex, and health. The model also included hypotheses about mediation between certain variables in the model. With regard to maternal psychosocial health, the model proposes that the relationship between child temperament and nutrition is mediated by maternal depression. It also posits that the relationship between maternal depression and child nutrition will be moderated by maternal support network, maternal intelligence, and child temperament. This point is relevant to the findings of the current thesis, as Wachs’ proposed moderator variables were not measured and thus unaccounted for in the statistical analysis. Hence, their influence may have led to the null relationship in the current thesis between maternal depressive symptoms and child BMI-z scores. Alternatively, the use of child BMI-z scores as the sole outcome measure of obesity risk may not have illustrated the complex relationship between other child obesity risk factors, such as nutrition, and maternal psychosocial health. The latter suggestion is supported by El-Belhadli et al.’s (2015) systemic theory of child obesity. Based on Wachs’ (2008) theoretical model, El-Belhadi et al. extended the model to include maternal stress, eating behaviours, feeding practices and child stress and eating
behaviours, which fall under the maternal and child resources pillars of the model. Their work was based on a literature review that highlighted the associations between maternal stress, depression and child obesity risk, which the authors suggest result from poor emotional climate between parent and child. El-Belhaldi et al. argue that maternal stress and depression reduce the mother’s coping resources, which may lead to less responsiveness and sensitivity to children; this in turn may lead to maladaptive feeding practices, such as pressure to eat and restriction, and parenting styles, such as authoritarianism and permissiveness.

Previous research has supported the links between maternal depression and pressure to eat (Haycraft & Blissett, 2008a; Haycraft, Farrow, & Blissett, 2013; Ystrom et al., 2012a), and between parenting styles and depressive symptoms (Lovejoy et al., 2000; Topham et al., 2010a). Lovejoy et al. (2000) performed a meta-analysis of 46 observational studies of mother-child interactions, and reported that mothers with higher depressive symptoms were significantly more likely to engage in negative (anger, hostility) and disengaged parenting styles. Topham et al. (2010) reported that maternal depressive symptoms moderated the relationship between permissive parenting style and child obesity, with depression linked to a six fold increased risk of obesity in children of permissive mothers. Braungart-Rieker, Moore, Planalp, and Lefever (2014) also found maternal depression to be associated with negative parenting (including authoritarian and permissive styles) with 3-6 year old children. Although maternal depression was not related directly to child BMI, negative parenting was associated with child impulsivity, which was linked to higher child food approach scores (i.e., food responsiveness, enjoyment, and emotional overeating), and this in turn was related to higher child BMI. A qualitative analysis by Southwell and Fox (2011) also noted that mothers with mental health issues,
including depression, influenced parenting and feeding practices, which led to permissiveness with feeding and minimization of their overweight or obese child’s weight status to reduce anxiety relating to others judging them to be bad mothers.

Based on this research, it may be the case that maternal psychosocial health influences child obesity risk in a more indirect form – through maladaptive parenting styles and feeding practices other than restriction and pressure to eat. As these were not measured in the present thesis, it is unknown whether such relationships exist in our sample. Although the theories proposed by Wachs (2008) and El-Belhaldi et al. (2015) provide meaningful consideration of the subtleties in the relationships between child obesity risk factors, they focus only on how maternal depression is related to child nutrition. On the other hand, the model proposed by Harrison et al. (2011) also allows for the consideration of psychosocial indices other than maternal depression in the understanding of child obesity aetiology, but misses the finer complexities of the mechanisms through which mothers’ psychosocial health actually poses a risk to their offspring’s weight. Thus, it may be helpful to consider the work of Wachs (2008) and El-Belhaldi et al. (2015) in addition to Harrison et al.’s (2011) developmental ecological model for a more thorough conceptualisation of the complexities of such relationships.

**Practical Implications**

The findings of the present thesis have several implications for prevention and intervention strategies targeted at child obesity. With regard to child obesity intervention and prevention, success is rare. A review by Spruijt-Metz (2011) highlighted the low rate of successful intervention and prevention strategies for childhood obesity as found by several other rigorous systematic reviews (Atlantis, Barnes, & Singh, 2006; Dobbins, De Corby, Robeson, Husson, & Tirilis, 2009;
Luttikhuis et al., 2009; McGovern et al., 2008; Summerbell et al., 2005) reviewed over 60 randomised controlled trial intervention studies that consisted of overweight or obese children ranging in age from 2-18 years. Meta-analyses found that only 23% reported a significant reduction in child weight outcomes (BMI or adiposity). Pharmacotherapy with sibutramine had a large effect on BMI reduction compared to a placebo drug, with an average reduction of 2.4 BMI units. Interventions targeting diet and sedentary behaviours had no impact on child weight outcomes, whilst physical activity interventions showed moderate effect sizes in reducing adiposity, but had no relationship to BMI. When all lifestyle interventions (diet, physical activity and sedentary behaviour) were considered collectively in the meta-analysis, a small to moderate effect size was reported for the intervention groups, and interventions that involved the parents’ delivery, and when children were younger than eight. This demonstrates the importance of interventions for child obesity containing a strong parental component, and that these interventions work best when delivered prior to late childhood. In terms of prevention, a recently published Cochrane review of child obesity intervention strategies by Waters et al. (2012) concluded that supporting parents to encourage healthy behaviours in the home environment (i.e., engage in physical activity, eat nutritious foods and reduce sedentary behaviour) was characteristic of effective interventions. However, when examining the studies by age group, only two of the eight studies that were implemented in 0-5 year olds demonstrated efficacy in reducing child obesity risk. One study found the intervention group only benefited in underprivileged areas, whilst those in privileged areas had no benefit over controls (Jouret et al., 2009), and the other found the intervention group stabilised their BMI over time, but did not significantly reduce it (Keller et al., 2009). Importantly, these studies mainly targeted school-age children (6-12 years), and thus
Skouteris, Hill, McCabe, Swinburn, and Busija (2015) recently published results of their MEND 2-4 intervention for pre-schooler obesity, a randomised controlled trial, which followed children up to 12 months post intervention. The intervention included both children and parents, who undertook ten 90-minute sessions during the intervention period, participating in active play, healthy snack-time, and education sessions for the parents. The education surrounded physical activity, nutrition and eating behaviours, sedentary behaviours, and parenting practices and skills training, including healthy modelling. Skouteris et al. found a significant increase in vegetables and snack food intake, and satiety responsiveness immediately post-intervention, and reduced neophobia (fear of new foods) post-intervention and at 12 month follow-up in the intervention group, relative to controls. There was, however, no change in child BMI-z, physical activity or sedentary behaviour at any time-point post intervention.

Lioret et al. (2012) also conducted a randomised controlled trial of an intervention targeted at enhancing parenting behaviours to encourage healthy eating, physical activity and discourage sedentary behaviour. The study included 542 mother-infant pairs; infants were between 3-18 months at study entry. The intervention was provided as six two-hour sessions given at a parenting group, delivered quarterly over 15 months by a dietician. Outcomes were measured for mothers only. Changes from baseline to post-intervention were significant for reductions in high-energy snacks, processed food and high fat foods in the intervention group only. There were no changes in physical activity, TV viewing time, fruit and vegetable intake or cereal and sweet food intake.

Willis et al. (2014) provided a brief, eight-week intervention program for
parents and pre-schoolers, which included a family time component for parents and children to eat a healthy snack together and engage in active play, and a parental education program that focused on diet and physical activity. Post-intervention the researchers found significant improvements in parents’ self-efficacy around setting limits, the frequency of the family sitting down together for a meal, the frequency of home cooked meals, and significantly less TV viewing during meal times. Physical activity, TV viewing time and parental BMI all remained unchanged.

These intervention studies all appeared to have a positive impact on parental eating and feeding behaviours as a means for reducing pre-schooler obesity risk, however physical activity, sedentary behaviour and weight status itself were not affected by the interventions. With regard to prevention studies, Fitzgibbon et al. (2005) conducted a randomised controlled trial of obesity prevention with African American parents and their pre-schoolers in the US. Over a 14-week period, weekly newsletters were provided to parents via their child’s pre-school, which contained information relating to healthy eating and sedentary behaviour. Children were also provided homework, which taught them about healthy eating and physical activity. At two years post-intervention, the intervention group were found to have gained significantly less weight, and have significantly lower BMIs than children in the control condition. There were no group differences for measures of physical activity and diet however. Furthermore, this same intervention was conducted in a sample of Latino parents and pre-schoolers, and was found to have no impact on obesity risks (weight, physical activity and diet) between intervention and control groups at two-year follow-up. Thus, it is important that researchers consider culture and how that may impact on treatment efficacy when designing intervention and prevention programs for pre-schooler obesity. It is however promising that a brief and simple
intervention that did not require any extra time of parents was successful at preventing weight gain in one population.

Of note, none of these interventions included targeted psychosocial health as a point for intervention. In light of the findings of the current thesis, it may be useful for future interventions to address maternal psychosocial difficulties (if present) and develop maternal coping skills to increase parenting resources and positive parenting practices. Interventions may also include psycho-education around the relationship between maternal mental health and child physical and mental health, particularly body dissatisfaction. As suggested in the ecological model proposed by Harrison et al. (2011), factors within each layer have a bidirectional relationship. Skouteris et al. (2011b) have argued specifically that the mother-child relationships surrounding obesity are bi-directional, thus interventions need to address not only the direction of mother to child, but child to mother. For example, mothers should be educated on how their child’s temperament, personality, eating habits and weight can influence how mothers interact with and feed their children, and even the unconscious messages they send their children via modelling. Mothers dealing with their own mental health problems already have less resources to direct their children toward engaging in obesity protective behaviours (Lovejoy et al., 2000; McLearn et al., 2006a; Paulson, Dauber, & Leiferman, 2006a; Topham et al., 2010a), thus the bidirectional influences from child to mother further increase the complexity and place these mothers and children at risk. Clearly, the need to first address maternal mental health is crucial in preventing pre-schooler obesity.

**General Limitations**

There are several limitations of the present thesis that must be acknowledged. Although an accurate measure of obesity risk, the use of BMI-z scores only as an
indicator of child obesity risk in the empirical studies may have limited the possibility of finding significant results. For example, the systematic review presented in Chapter Two found that maternal depressive symptoms were related to less physical activity and higher sedentary behaviours in pre-schoolers. Thus, examining the various avenues through which obesity exerts itself would have provided a more comprehensive understanding of the ways in which maternal psychosocial health may be related to pre-schooler obesity.

There were several other variables of interest that were not measured, however may have added to our understanding of maternal influences on pre-schooler obesity. These include child variables, such as temperament and personality, and their bidirectional relationship to mothers’ psychosocial health and feeding practices. As theoretical models referred to above suggest (El-Belhaldi et al. 2015; Wachs, 2008), it may have also been helpful to include maternal parenting styles, stress, intelligence and support resources as possible mediators of the relationship between psychosocial health, feeding and pre-schooler BMI-z. Furthermore, the psychosocial measures that were employed did not have available validated cut-off scores to allow for comparisons between samples. The independent t-tests used to compare the groups of mothers with and without elevated scores on the psychosocial measures were also uncontrolled, thus results were possibly confounded by unaccounted covariates. The studies are also limited by the exclusive measurement of others, as fathers and alternative caregivers such as grandparents and carers may also contribute to pre-schooler obesity risk. A systematic review examining the influence of paternal factors and pre-schooler weight concluded that fathers’ parenting and feeding styles, as well as warmth and beliefs regarding weight and eating all impacted on child weight status, in both directions (Fraser et al., 2011).
The reliance on subjective, self-report measures of all variables may be a large limitation of the current thesis. There was only a medium correlation between maternal reported and objectively measured child height and weight data in a subsample of participants at baseline, and previous research has reported low accuracy of mothers’ reports of child height and weight, with height tending to be overestimated and weight underestimated (O'Connor & Gugenheim, 2011). Other research has found that parental report of pre-schooler weight is generally accurate when measured at home, but not when estimated (Huybrechts et al., 2011). Given the medium correlations between maternal report and objective measurements in the current sample, it seems more likely that mothers based their reports on estimates rather than home measurements. In light of O'Connor and Gugenheim’s (2011) research, it is also possible that overweight and obesity were underestimated within the current sample, reducing the target population and therefore also reducing statistical power. Maternal self-report of their psychosocial health may have also led to underestimations of severity due to socially desirable responding. Observational measurement of mother-child interactions would have been ideal to examine whether bidirectional mother-child relationships play a role in the maternal psychosocial health-child obesity link.

Further investigation into whether child sex is important in the relationship between maternal psychosocial health and pre-schooler obesity risk is warranted. Due to the large number of variables included for analysis in the empirical studies, separate analyses by child sex were not possible to maintain statistical power. However, as past research has found differences between male and female children with regard to the influence of both maternal psychosocial health and feeding practices on obesity risks, further research examining the differences in the
relationship between maternal psychosocial health and pre-schooler obesity between the sexes specifically is warranted.

It is also important to acknowledge that the sample studied was demographically homogeneous. Participants were predominantly Australian-born, married or de facto, and high socio-economic status (based on income and education). The marriage rates and socioeconomic level were higher than the most recent Australian norms (Australian Bureau of Statistics, 2013b, 2013c; Baxter, 2013; Organisation for Economic Co-operation and Development, 2011). Hence, results cannot be extended to mothers and children of lower socioeconomic backgrounds, single mothers, or those of other nationalities. It should also be noted that the results of the current thesis were based on a convenience sample who volunteered their participation, and that the response rate for surveys mailed out was 56%. Previous research has noted participation bias in favour of those with higher SES and educational attainment (Lissner et al., 2003). This may explain the homogeneity of the current sample with regard to demographic variables.

There were also low percentages of the variables of interest within the current sample, that is, mothers with elevated scores on the psychosocial measures and children with obesity. While the low prevalence is not unusual given the high SES characteristics of the sample, obtaining higher percentages of mothers and children evidencing psychosocial health issues and obesity, respectively, may have increased the statistical power to detect a significant relationship between these variables in the current thesis.

Conclusions and Final Remarks

With child obesity rates increasing around the world, and typical physical activity and nutrition interventions unable to address these climbing rates, research is
now turning to other possible contributors to child obesity, such as maternal characteristics. There is also a need to address obesity risks early on, before life-long patterns of physical activity and diet are formed, thus the pre-school age is also gaining attention. The studies within this thesis were the first to examine the relationship between maternal psychosocial health and pre-schooler obesity risk.

The findings of the current thesis add to the literature on pre-schooler obesity by identifying that children of mothers with higher body dissatisfaction may have an increased obesity risk, irrespective of maternal child feeding practices. The results also suggest that relationships between maternal psychosocial measures and pre-schooler obesity may not exist in Australian samples that have high socio-economic status. Future research should explore these relationships in wider populations, such as low socio-economic status and ethnically diverse samples, to aid the understanding of the conditions under which maternal psychosocial health impacts on pre-schooler weight. Future research should also include other measures of obesity risk, such as physical activity, nutrition-related variables and sedentary behaviours to inform prevention and intervention efforts designed to increase positive parenting behaviours that encourage and establish healthy lifestyle habits in young children during their formative preschool years.
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Appendix A – Study Advertisement

PRE–SCHOOL WELL BEING STUDY

Mothers and fathers with 2 to 4-year-old children are invited to take part in a study looking at what factors may be associated with weight changes among preschool children. At present, whilst considerable research has been dedicated to identifying factors contributing to weight changes in school-aged children and adolescents, little is known about these factors among preschool children.

The study is supervised by Dr Helen Skouteris, Professor Marita McCabe and Associate Professor Lina Ricciardelli from the School of Psychology, Deakin University, Professor Jeannette Milgrom (School of Behavioural Science, The University of Melbourne) and Professor Louise Baur (Children’s Hospital Westmead, Sydney)

If you agree to participate, you will be sent a set of questionnaires twice a year for three years, which take approximately 50-70 minutes to complete. These are then returned to the university in a reply paid envelope provided. We will also invite you to take part in two video-taped home visits (one year apart) of mother-child and father-child interactions. Each home visit will take about 1.5 hours. The parent-child will be videotaped during a variety of typical daily routines, such as preparing a snack for the child, free play, and TV viewing. Parents will be able to keep a copy of the video taken.

If you are interested in participating in this vital research or would like more information about our study, please contact the project manager:

Daniela Dell’Aquila, School of Psychology, Deakin University, Victoria 3125

Phone: (03) 9251-7406

Email: daniela.dellaquila@deakin.edu.au
TO: Mothers of 2-4 year old children

PLAIN LANGUAGE STATEMENT

Date: March 2010

Full Project Title: Weight changes among preschool children.

Principal Researchers: Dr Helen Skouteris, Professor Marita McCabe, Associate Professor Lina Ricciardelli (School of Psychology, Deakin University, Burwood), Professor Jeannette Milgrom (School of Behavioural Science, The University of Melbourne) and Professor Louise Baur (Children’s Hospital Westmead, Sydney)

Research Assistant and Project Manager: Ms Daniela Dell’Aquila

Student Researchers (supervised by Dr Helen Skouteris): Skye McPhie (DPscyh Health) Defne Demir, (DPsych Health), Josephine Frazer, (DPsych Clinical), Jessica Mitchell (Masters Clinical) and Rachael Cox (Honours).

1. Your Consent

You, your child aged 2-4 years of age, and your husband/father of your child aged 2-4 years of age are invited to take part in this research project.

This Plain Language Statement contains detailed information about the research project. Its purpose is to explain to you as openly and clearly as possible all the procedures involved in this project so that you can make a fully informed decision whether you are going to participate.

Once you understand what the project is about and if you agree to take part in it, you will be asked to sign the Consent Form. By signing the Consent Form, you indicate that you understand the information and that you give your consent and consent on behalf of your child to participate in the research project. Your husband/father of your child aged 2-4 years of age must also provide his own consent to take part in this research. Please do this prior to completing the questionnaires.

You will be given a copy of the Plain Language Statement and Consent Form to keep as a record.

2. Purpose and Background

The purpose of the project is to determine what factors are associated with weight changes among preschool children. We will recruit 300 parents of 2-4 year old children and will ask them to complete a series of questionnaires twice each year for three years. Whilst a large body of research has identified what factors contribute to
weight changes in school-aged children and adolescents, less is known about these factors among preschool children. You are invited to participate in this research project because you have a child aged between 2-4 years of age.

3. Funding
The study is being funded by The Australian Research Council Discovery grant scheme which was awarded in 2010 for a three year period.

4. Procedure
Participation in this project will involve parents (both the mother and father) completing a series of questionnaires two times each year for three years. The questionnaire package will take approximately 50-70 minutes to complete each time (i.e., at each of the two data collection time points each year) and will include questions about parental and child eating, feeding, physical activity, health and wellbeing, weight, height, as well as demographic information, such as age and family income. All questionnaires will be mailed to participants twice a year for three years. When completed, participants will be asked to send these back to the University using the reply paid envelopes provided.

We also invite parents to take part in two video-taped home visits of mother-child and father-child interactions. Each home visit will take about 1.5 hours for each parent-child pair, and will take place once a year for two consecutive years. The parent-child will be videotaped during a variety of typical daily routines, such as preparing a snack for the child, free play, and TV viewing. Parents will be able to keep a copy of the video taken.

5. Possible Benefits
This project is important because the data collected will assist in developing evidence-based educational materials for parents, teachers and health professionals and will allow for prevention and intervention strategies to be devised that are targeted specifically towards maintenance of healthy weight in preschool children.

6. Possible Risks
We will ask you general questions about your eating and physical activity and about your general well being. If any of the questions make you feel uncomfortable or you become distressed and you wish to speak to someone about that please call Dr Helen Skouteris on 9251 7669.

7. Privacy, Confidentiality and Disclosure of Information
You can be assured that you and your child will not be identified by name in any way in the reporting of our results in publications and conference presentation. Any information we collect from you that can identify you will remain confidential and will be stored in a locked cabinet within the School of Psychology at Deakin University for a minimum of 6 years from the date of publication.

8. Results of Project
A summary of the findings will be provided to the school and available for any interested parents to read at the completion of the study. Please email helens@deakin.edu.au to receive this report.
9. Participation is voluntary

Participation in any research project is voluntary. **If you do not wish to take part you are not obliged to.** If you decide to take part and later change your mind, you are free to withdraw from the project at any stage. Any information obtained from you to date will not be used and will be destroyed. Your decision whether to take part or not to take part, or to take part and then withdraw, will not affect your relationship with Deakin University.

Before you make your decision, a member of the research team will be available to answer any questions you have about the research project. You can ask for any information you want. Sign the Consent Form only after you have had a chance to ask your questions and have received satisfactory answers.

If you decide to withdraw from this project, please notify a member of the research team so they can inform you if there are any special requirements linked to withdrawing.

10. Ethical Guidelines

The study will be carried out in accordance with the National Statement on Ethical Conduct in Human Research (2007). This statement has been developed to protect the interests of people who agree to participate in human research studies.

The ethics aspects of this research project have been approved by the Human Research Ethics Committee of Deakin University. The research will be carried out in the School of Psychology Deakin University, 221 Burwood Highway, Burwood Victoria.

11. Complaints

Should you have any concerns about the conduct of this research project, please contact the Manager, Research Integrity, Research Services Division, Deakin University, 221 Burwood Highway, Burwood Victoria, 3125. Telephone: 9721-7129, Facsimile: 9244 6581; research-ethics@deakin.edu.au. Please quote project number EC 62 - 2008.

12. Reimbursement for your costs

You will not be paid for your participation in this project. However, if you remain a participant in this study over the three years you will be entered into a prize draw to win one of 20 X $50 gift vouchers.

13. Further Information:

Contact Dr Helen Skouteris in the School of Psychology, Deakin University, 221 Burwood Highway, Burwood, Victoria, 3125, on 9251 7699 or email: helens@deakin.edu.au
TO: Parents

Consent Form
Researcher’s Copy

Date: June, 2009
Full Project Title: Weight changes among preschool children.

Principal Researchers: Dr Helen Skouteris, Professor Marita McCabe, and Associate Professor Lina Ricciardelli (School of Psychology, Deakin University, Burwood) Professor Jeannette Milgrom (School of Behavioural Science, The University of Melbourne) and Professor Louise Baur (Children’s Hospital Westmead, Sydney)

I have read and I understand the attached Plain Language Statement.

I freely consent to participate in this project according to the conditions in the Plain Language Statement.

I have been given a copy of the Plain Language Statement and Consent Form to keep.

The researchers have agreed not to reveal my identity and personal details, including where information about this project is published, or presented in any public form.

Mother’s Name (Printed)

.......................................................... ..................................................

Mother’s Signature.................................................................Date..................

.....
The researchers will be applying for further funding to continue their research longer term. If you agree to be contacted for research studies of this type in the future please sign below.

I consent to the researchers named here contacting me for future research studies that I am not obliged to take part in.
Parent’s name: ..........................................................
Signature:......................................................

Parent’s name: ..........................................................
Signature:......................................................

Please return the signed form to: Dr Helen Skouteris, School of Psychology, Deakin University, 221 Burwood Highway, Burwood, Victoria 3125.
TO: Parents

Third Party Consent Form
Researcher’s Copy

Date: June, 2009

Full Project Title: Weight changes among preschool children

I have read and I understand the attached Plain Language Statement.

I give my permission for my child aged 2-4 years of age to participate in this project according to the conditions in the Plain Language Statement.

I have been given a copy of Plain Language Statement and Consent Form to keep.

The researcher has agreed not to reveal my child’s identity and personal details, including where information about this project is published, or presented in any public form.

Child’s Name (printed) .................................................................

Name of Person giving Consent (printed) ...........................................

Relationship to Participant: ............................................................

Signature ................................................................. Date

........................................
Please return the signed form to: Dr Helen Skouteris, School of Psychology, Deakin University, 221 Burwood Highway, Burwood, Victoria 3125.

DEAKIN UNIVERSITY
PLAIN LANGUAGE STATEMENT AND CONSENT FORM

TO: Parents

Consent Form
Participant’s Copy

Date: June, 2009
Full Project Title: Weight changes among preschool children.

Principal Researchers: Dr Helen Skouteris, Professor Marita McCabe, and Associate Professor Lina Ricciardelli (School of Psychology, Deakin University, Burwood) Professor Jeannette Milgrom (School of Behavioural Science, The University of Melbourne) and Professor Louise Baur (Children’s Hospital Westmead, Sydney)

I have read and I understand the attached Plain Language Statement.
I freely consent to participate in this project according to the conditions in the Plain Language Statement.

I have been given a copy of the Plain Language Statement and Consent Form to keep.

The researchers have agreed not to reveal my identity and personal details, including where information about this project is published, or presented in any public form.

Mother’s Name (Printed)

.................................................................

Mother’s Signature............................................Date..........................

.....

Father’s Name (Printed)

.................................................................

Father’s Signature............................................Date..........................

.....

Parents’ Contact Details

Address:........................................................................................................

..............

.................................................................

..............

Home Phone:.........................................................
The researchers will be applying for further funding to continue their research longer term. If you agree to be contacted for research studies of this type in the future please sign below.

I consent to the researchers named here contacting me for future research studies that I am not obliged to take part in.

Parent’s name: ................................................
Signature:..............................................

Parent’s name: ................................................
Signature:..............................................

Please retain the signed form for your records. If you have any questions please do hesitate to contact: Dr Helen Skouteris, School of Psychology, Deakin University, 221 Burwood Highway, Burwood, Victoria 3125.
TO: Parents

Full Project Title: Weight changes among preschool children

I have read and I understand the attached Plain Language Statement.

I give my permission for my child aged 2-4 years of age to participate in this project according to the conditions in the Plain Language Statement.

I have been given a copy of Plain Language Statement and Consent Form to keep.

The researcher has agreed not to reveal my child’s identity and personal details, including where information about this project is published, or presented in any public form.

Child’s Name (printed) …………………………………………………………………………

Name of Person giving Consent (printed) ……………………………………………………

Relationship to Participant: …………………………………………………………………

Signature ………………………………………………………………………… Date:

…………………………
Please retain the signed form for your records. If you have any questions please do not hesitate to contact: Dr Helen Skouteris, School of Psychology, Deakin University, 221 Burwood Highway, Burwood, Victoria 3125.
Appendix C – Cover letter and questionnaire

School of Psychology
Deakin University
221 Burwood Highway
Burwood, Victoria 3125

Hello and welcome to our study: “Weight Changes among Preschool Children”.

We would like to thank you for agreeing to take part in this study. Studies such as this contribute enormously to our knowledge base about factors contributing to weight changes in young children. As this knowledge base expands, clinicians in the field will be better informed about what factors contribute to a healthy lifestyle for preschool children.

The present questionnaire pack should take approximately 70 minutes to complete. If you begin filling out the questionnaires and feel you do not wish to continue further you can stop. If the questionnaires raise personal concerns for you, you can call Miss Sofia Rallis on …………… or Dr Helen Skouteris on 9251-7699 to discuss these concerns.

Please fill in the questionnaires as accurately as possible and return them in the reply paid envelope provided. All your responses will remain strictly anonymous and confidential.
Yours Sincerely,

The Research Team

Project Manager: Sofia Rallis

Principal Researchers: Dr Helen Skouteris, Professor Marita McCabe and Associate Professor Lina Ricciardelli.

School of Psychology
Deakin University
221 Burwood Highway
Burwood, Victoria 3125

ID No: __________

Demographics Info – Mother

Section One: Background/Mother Information

To Be Completed By Mother
The following questions ask about your child, yourself and your family. Some questions relate to how you feel about yourself and how you feel as a parent, while other questions relate to various behaviours and beliefs.

All responses are strictly confidential.

Please add the date you are filling in this questionnaire below and then answer the following questions with your child aged between 2 - 4 years in mind. If you have more than one child in this age range, please think of only one of these children when completing the information below. Please circle the appropriate responses.

Today's date: ……/……/……

1. Your date of birth (dd/mm/yyyy) ...............................................................................................................

2. Home Phone Number ..............................................................................................................................

3. Mobile Phone Number ............................................................................................................................

4. Your child’s date of birth (dd/mm/yyyy) ..................................................................................................

   Sex of your child: (1) Female (2) Male

   Are you the primary care giver? (1) Yes (2) No
If No, please state who is: .................................................................

5. Was this child born at term (between 37 and 40 weeks gestation)?
   (1) Yes    (2) No
   If No, what was your child’s gestation age at birth?
   Number of weeks: ..............................................................

6. What is your current weight and height? If you do not have scales at home, your local pharmacy or GP will have scales that you can use to weigh yourself
   Weight: .................................................... kg
   Height: .................................................... cm

7. What was your pre-pregnancy weight (for this child)? If you do not know exactly, please make a “best” estimate.
   Weight: .................................................... kg

8. What was the pre-pregnancy weight and height of the father of your child? If you do not know exactly, please make a “best” estimate.
   Weight: .................................................... kg
   Height: .................................................... cm

To indicate your response to each of the following questions, please circle the appropriate responses, or write your responses in the space provided.

9. Your occupation is: .................................................................

10. Your partner’s occupation is: ..............................................
11. Number of children you have: (1) (2) (3) (4) (5) (6) (6+)

12. This child is child number: ...................... (1= first born; 2 = second born etc).

   Married

14. Are you an Aboriginal or Torres Strait Islander? (1) Yes (2) No

15. Location of your birth: (1) Australia (2) New Zealand (3) North-West Europe (4) North America (5) Southern & Eastern Europe (6) South America (7) North Africa & Middle East (8) Southern & Central Asia (9) Central, Western & Southern Africa

16. Where were your parents born? (Name of country please):
   Father: .................................................
   Mother: .................................................

17. Main language spoken at home:
   (1) English
   (2) Other (please specify): .................................................................
18. Please indicate the highest level of education you have completed.

(1) Still at secondary school  (2) Did not finish secondary school  
(3) Year 12 or equivalent  (4) Certificate Level  
(5) Advanced Diploma/Diploma  (6) Graduate Diploma/Graduate Certificate  
(7) Bachelor Degree Certificate  (8) Postgraduate Degree

19. Have you completed a trade certificate?

(1) No  (2) Yes, trade certificate or apprenticeship

20. Are you currently in paid employment?  

(1) YES  (2) NO  
(If No, please go to the Question 23)

If Yes, do you work full time/part time?

----------------------------------------------------------------------------------------------------------------------------------
What is your role at work?
----------------------------------------------------------------------------------------------------------------------------------

21. Does your employer provide work-based child care?  

(1) YES  (2) NO

22. What care arrangements do you use for your child when you are at work? For each type of childcare chosen below please note also how many days per week your child is in that care. (You may choose more than one).

(1) Grandparent ……… days per week  (2) Sister/other relative………days per week
(3) Nanny ………………days per week  (4) Neighbour…………………days per week

(5) Centre based childcare provided by your work …………………………..…days per week

(6) Centre based childcare provided by your partner’s work ……………………days per week

(7) Centre based childcare away from work ……………………days per week

(8) Family day-care……………………………………………..…days per week

(9) Other (please specify)…………………………………………………………days per week

23. Please indicate your approximate annual family income:

   (1) Under 25,000  (2) 25,001- 45,000
   (3) 45,001- 65,000  (4) 65,001- 85,000
   (5) 85,001- 105,000  (6) 105,001- 125,000
   (7) 125,001- 145,000  (8) Over 145,001

Beck Depression Inventory

Circle ONE letter for each question to show the way YOU feel today, that is, right now! If more than one statement for each question seems to apply equally well, circle each one.

1. (a). I do not feel sad.
(b). I feel sad.
(c). I am blue or sad all the time and I can't snap out of it.
(d). I am so sad or unhappy that I can't stand it.

2. (a). I am not particularly discouraged about the future.
(b). I feel discouraged about the future.
(c). I feel I have nothing to look forward to.
(d). I feel that the future is hopeless and that things cannot improve.

3. (a). I do not feel like a failure.
(b). I feel I have failed more than the average person.
(c). As I look back on my life, all I can see is a lot of failures.
(d). I feel I am a complete failure as a person.

4. (a). I am not particularly dissatisfied.
(b). I don't enjoy things the way I used to.
(c). I don't get satisfaction out of anything anymore.
(d). I am dissatisfied with everything.

5. (a). I don't feel particularly guilty.
(b). I feel bad or unworthy a good part of the time.
(c). I feel quite guilty.
(d). I feel as though I am very bad or worthless.

6. (a). I don't feel disappointed in myself.
(b). I am disappointed in myself.
(c). I am disgusted in myself.
(d). I hate myself.

7. (a). I have not lost interest in other people.
(b). I am less interested in other people now than I used to be.
(c). I have lost most of my interest in other people.
(d). I have lost all of my interest in other people and don't care about them at all.

8. (a). I make decisions about as well as ever.
(b). I try to put off making decisions.
(c). I have great difficulty in making decisions.
(d). I can't make any decisions at all anymore.

9. (a). I don't feel I look worse than I used to.
(b). I am worried that I am looking old or unattractive.
(c). I feel that there are permanent changes in my appearance and that makes me look unattractive.
(d). I feel that I am ugly or repulsive looking.
10. (a). I can work about as well as before.
   (b). It takes extra effort to get started at doing something.
   (c). I have to push myself very hard to do anything.
   (d). I can't do any work at all.

11. (a). I don't get any more tired than usual.
   (b). I get tired more easily than I used to.
   (c). I get tired from doing anything.
   (d). I get too tired to do anything.

12. (a). My appetite is no worse than usual.
   (b). My appetite is not as good as it used to be.
   (c). My appetite is much worse now.
   (d). I have no appetite at all anymore.

13. (a). I don't have any thoughts of killing myself.
   (b). I have thoughts of killing myself but I would not carry them out.
   (c). I would like to kill myself.
   (d). I would kill myself if I had the chance.

Rosenberg Self-Esteem Scale

*Please tick ONE set of brackets for each statement*
1. On the whole I am satisfied with myself ( ) ( ) ( ) ( )
2. At times I am no good at all. ( ) ( ) ( ) ( )
3. I feel that I have a number of good qualities ( ) ( ) ( ) ( )
4. I am able to do things as well as most other people. ( ) ( ) ( ) ( )
5. I feel I do not have much to be proud of. ( ) ( ) ( ) ( )
6. I certainly feel useless at times. ( ) ( ) ( ) ( )
7. I feel I am a person of worth, at least on equal plane with others. ( ) ( ) ( ) ( )
8. I wish I could have more respect for myself. ( ) ( ) ( ) ( )
9. All in all I am inclined to think I am a failure. ( ) ( ) ( ) ( )
10. I take a positive attitude toward myself. ( ) ( ) ( ) ( )

**State-Trait Anxiety Scale: - Trait Subscale**

Tick ONE set of brackets for each statement about how you usually feel

<table>
<thead>
<tr>
<th>Not at All</th>
<th>Somewhat</th>
<th>Moderately So</th>
<th>Very Much So</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
</tbody>
</table>

1. I feel pleasant ( ) ( ) ( ) ( )
2. I feel nervous and restless
3. I feel satisfied with myself
4. I wish I could be as happy as others seem
5. I feel like a failure
6. I feel rested
7. I am ‘cool, calm and collected’
8. I feel that difficulties are piling up so that I cannot overcome them.
9. I worry too much over something that really doesn’t matter
10. I am happy
11. I have disturbing thoughts
12. I lack self-confidence
13. I feel secure
14. I make decisions easily
15. I feel inadequate
16. I am content
17. Some unimportant thought runs through my mind and bothers me
18. I take disappointments so keenly that I can’t put them out of my mind
19. I am a steady person
20. I get in a state of tension and/or turmoil as I think over my recent concerns and interests

---

**Body Weight/Shape Questions**
Please place a tick or cross to the response that best applies to you. There is no right or wrong answer. It is important not too take too long to answer each question.

### Child Feeding Questionnaire

Please answer the following questions regarding your child’s eating and feeding behaviours. To indicate your response to each question, please tick the appropriate set of brackets. Answer the following questions with your child aged between 2 - 4 years in mind.

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Seldom</th>
<th>Half of the time</th>
<th>Most of the time</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. When your child is at home, how often are you responsible for feeding him/her?</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>2. How often are you responsible for deciding what your child’s portion sizes are?</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>3. How often are you responsible for deciding if your child has eaten the right kind of foods?</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
</tbody>
</table>

Un- Concerned | A Little Concerned | Concerned | Fairly Concerned | Very Concerned
4. How concerned are you about your child eating too much when you are not around him/her?

5. How concerned are you about your child having to diet to maintain a desirable weight?

6. How concerned are you about your child becoming overweight?

7. I have to be sure that my child does not eat too many sweets (e.g., candy, ice-cream, cakes).

8. I have to be sure that my child does not eat too many high-fat foods.

9. I have to be sure that my child does not eat too much of his/her favourite foods.

10. I intentionally keep some foods out of my child’s reach.

11. I offer sweets (e.g., candy, ice-cream, cakes, pastries etc) to my child as a reward for good behaviour.

12. I offer my child his/her favourite foods in exchange for good behaviour.

13. If I did not guide or regulate my child’s eating, he/she would eat too many junk foods.

14. If I did not guide or regulate my child’s eating, he/she would eat too much of his/her favourite foods.

15. My child should always eat all of the food on his/her plate.
16. I have to be especially careful to make sure my child eats enough. ( ) ( ) ( ) ( ) ( )

17. If my child says “I’m not hungry” I try to get him/her to eat anyway. ( ) ( ) ( ) ( ) ( )

18. If I did not guide or regulate my child’s eating, he/she would eat much less than he/she should. ( ) ( ) ( ) ( ) ( )

19. How much do you keep track of the sweets (e.g., candy, ice-cream, cakes, pastries) that your child eats? ( ) ( ) ( ) ( ) ( )

20. How much do you keep track of the snack food (e.g., potato chips, Doritos, cheese puffs) that your child eats? ( ) ( ) ( ) ( ) ( )

21. How much do you keep track of the high-fat foods that your child eats? ( ) ( ) ( ) ( ) ( )

<table>
<thead>
<tr>
<th>Markedly</th>
<th>Under-weight</th>
<th>Normal</th>
<th>Over-weight</th>
<th>Markedly Overweight</th>
</tr>
</thead>
</table>

22. Thinking back, how do you perceive your own weight status for your childhood (5-10 years old)? ( ) ( ) ( ) ( ) ( )

<table>
<thead>
<tr>
<th>Markedly</th>
<th>Under-weight</th>
<th>Normal</th>
<th>Over-weight</th>
<th>Markedly Overweight</th>
</tr>
</thead>
</table>

23. Thinking back, how do you perceive your own weight status for your adolescence? ( ) ( ) ( ) ( ) ( )

<table>
<thead>
<tr>
<th>Markedly</th>
<th>Under-weight</th>
<th>Normal</th>
<th>Over-weight</th>
<th>Markedly Overweight</th>
</tr>
</thead>
</table>
24. Thinking back, how do you perceive your own weight status for your 20s? (   ) (   ) (   ) (   ) (   ) (   )

25. How do you perceive your own weight at present? (   ) (   ) (   ) (   ) (   ) (   )

26. Thinking back, how do you perceive your child's weight during the first year of his/her life? (   ) (   ) (   ) (   ) (   ) (   )

27. How do you perceive your child's weight at present? (   ) (   ) (   ) (   ) (   ) (   )
Appendix D – Ethics approval

Human Research Ethics
DEAKIN UNIVERSITY AUSTRALIA

Deakin Research Integrity
70 Elgar Road Burwood Victoria
Postal: 221 Burwood Highway
Burwood Victoria 3125 Australia
Telephone 03 9251 7123 Facsimile 03 9244 6581
research-ethics@deakin.edu.au

Memorandum

To: A/Prof Helen Skouteris
School of Psychology

From: Deakin University Human Research Ethics Committee (DUHREC)

Date: 25 November, 2011

Subject: 2008-062

Overweight and obesity among pre-school children: A prospective study to determine risk and protective behaviours

Please quote this project number in all future communications

The modification to this project, submitted on 11/11/2011, has been approved by the committee executive on 25/11/2011.

Approval has been given for A/Prof Helen Skouteris, School of Psychology, to continue this project as modified to 31/12/2013.

The approval given by the Deakin University Human Research Ethics Committee is given only for the project and for the period as stated in the approval. It is your responsibility to contact the Human Research Ethics Unit immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time.
- Any events which might affect the continuing ethical acceptability of the project.
- The project is discontinued before the expected date of completion.
- Modifications are requested by other HRECs.

In addition you will be required to report on the progress of your project at least once every year and at the conclusion of the project. Failure to report as required will result in suspension of your approval to proceed with the project.

DUHREC may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007).

Human Research Ethics Unit
research-ethics@deakin.edu.au
Telephone: 03 9251 7123