Research report

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Do maternal body dissatisfaction and dietary restraint predict weight gain in young pre-school children? A one-year follow-up study

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Abstract

Background: The relationships between maternal body image and eating concerns and increases in body mass index (BMI) in early childhood are poorly understood. Our aim was to test a model in which mothers' BMI, body dissatisfaction, dietary restraint and concerns about their child's weight were related to restrictive feeding practices and child BMI*z* change.

Methods: Mothers of 2-year-old children (n = 202, aged between 1.5 and 2.5 years) reported concerns regarding their own and their child's weight, their dietary restraint, and restrictive feeding practices. Height and weight were measured for children and reported by mothers at baseline and 1-year later.

Results: Thirty five percent of mothers and 29% of children were in overweight or obese categories at baseline. Using path analysis, after adding an additional pathway to the proposed model the final model provided a good fit to the data (χ^2 (8) = 5.593, p =.693, CFI = 1.000, RMSEA = .000), with maternal dietary restraint directly predicting change in child BMI*z* over the year. Concern about child's weight and, to a lesser extent, maternal dietary restraint mediated the relationship between maternal body dissatisfaction and the use of restrictive feeding practices. However, the pathway from restrictive feeding practices to change in child BMI*z* was not significant.

Conclusions: Mothers' BMI and body dissatisfaction may contribute indirectly to weight change in their young children. Interventions targeting maternal body dissatisfaction and informing about effective feeding strategies may help prevent increases in child BMI*z*.

Keywords: Body dissatisfaction; dietary restraint; mothers; restrictive feeding; child weight gain

Background

The rising tide of childhood overweight and obesity has contributed to a research focus on modifiable risk factors for increases in BMI in children (Crouch, O'Dea, & Battisti, 2007), and evidence suggests that parent-child feeding practices and early parent-child interactions contribute to children's weight status (Faith et al., 2004; Fisher, Birch, Smiciklas-Wright, & Picciano, 2000; McPhie et al., 2011; Ventura & Birch, 2008). One category of child feeding practices that has at times been found to predict upward change in child BMI involves attempts to control or restrict a child's eating patterns and food intake (Birch, Fisher, & Davison, 2003). However, little empirical attention has been paid to factors that might be related to the use of feeding practices of this type. It has been suggested that, even among healthy weight mothers, the use of restrictive feeding practices could be influenced by mothers' own body image, weight and/or eating concerns (Francis, Hofer, & Birch, 2001). To date, while there is some evidence of a relationship between maternal body image and eating concerns and maternal feeding practices (e.g., Blissett, Meyer, & Haycraft, 2006), no models have been tested that describe mechanisms by which maternal BMI, body dissatisfaction, weight and eating attitudes may influence feeding practices and in turn child weight gain. The present study aimed to explore such a model among mothers of young preschool children using longitudinal data.

Maternal restriction of child food intake, in an effort to control and regulate the type and amount of food a child eats, has been identified as a potentially important factor in child overweight (Faith & Kerns, 2005). While the intention of restrictive feeding practices could be imagined to be to control child weight or promote healthier eating

habits among children, it has been suggested that these practices might be counterproductive by rendering the restricted foods more desirable and increasing children's preference for, and consumption of, these foods in the long term (Birch et al., 2003; Faith et al., 2004; Faith & Kerns, 2005). Consistent with this hypothesis, a number of studies (Birch et al., 2003; Faith et al., 2004), although not all (Campbell et al., 2010), have found a prospective and positive relationship between restrictive child feeding practices and later child BMI. The discrepancies in the literature may stem from methodological issues as the lack of consensus in the definition of parental feeding constructs, in particular that of restriction, has been highlighted (Jansen, Daniels, & Nicholson, 2012). This discord and the lack of validation of certain measures have contributed to divergent findings in this area. In addition, these divergent findings highlight the need for longitudinal research among very young children to help clarify these relationships.

Furthermore, the proposition that restrictive feeding practices stem from a desire to prevent child weight gain has been supported. While parents with high concerns about their child becoming overweight are not the majority, those who do express such concerns have been found to use higher levels of restrictive feeding practices (Gray, Janicke, Wistedt, & Dumont-Driscoll, 2010; May et al., 2007). Interestingly, while cross-sectional studies suggest that use of restrictive feeding practices is associated with concern about a child becoming overweight, they have not been shown to be linked to a child *being* overweight (Crouch et al., 2007; May et al., 2007).

Taken together these findings suggest that the preoccupations and weight concerns leading to restrictive feeding practices may derive more from a mother's own

93 weight concerns than her child's actual body weight. A mother's own weight-related
94 body dissatisfaction could lead to both dietary restraint (Baker, Carter, Cohen, &
95 Brownell, 1999; Skouteris, Carr, Wertheim, Paxton, & Duncombe, 2005) and higher
96 concerns regarding her child's risk of gaining weight and consequently the use of
97 similarly restrictive feeding patterns in healthy weight children.

98 In line with these propositions, some researchers have identified a cross-sectional
99 relationship between maternal concerns regarding her own weight and her concerns
100 regarding her child's weight, among 5-year-old girls (Francis et al., 2001). The proposed
101 relationship between maternal body image and eating concerns and maternal feeding
102 practices has also been supported. Parents with high levels of body dissatisfaction have
103 been found to be more likely to report the use of restrictive feeding practices (Gray et al.,
104 2010). Similarly, maternal dietary restraint, and bulimic symptoms have been cross-
105 sectionally associated with restrictive feeding practices in 5-year-olds (Blissett et al.,
106 2006; Francis et al., 2001). In their recent review, McPhie et al. found seven studies
107 assessing the relationship between maternal eating pathology (including body
108 dissatisfaction) and maternal feeding styles and reported that most of the studies provided
109 at least partial evidence for the relationship (McPhie, Skouteris, Daniels, & Jansen,
110 2012). However, few studies have explored the mechanisms through which maternal
111 eating behaviors and feeding practices are associated with child overweight.

112 Body mass index has consistently been shown to predict body dissatisfaction in
113 young women (e.g., Paxton, Eisenberg & Neumark-Sztainer, 2006). In addition, it has
114 been suggested that physical changes around pregnancy and the post-pregnancy period
115 contribute to the greatest deviations from the social thin-ideal that a woman will

experience, and the extent of these changes makes young mothers very vulnerable to body dissatisfaction (Jordan, Capdevila & Johnson, 2005). In particular, weight gain and retention after pregnancy has been shown to be related to weight concerns and BMI among young mothers has been shown to be associated with body dissatisfaction (Clark, Skouteris, Wertheim, Paxton & Milgrom, 2010; Rallis, Skouteris, Wertheim & Paxton, 2007). These findings suggest a model in which maternal BMI is positively associated with body dissatisfaction (Rallis et al., 2007), which is related to maternal dietary restraint and concern about her child's weight (Baker, Carter, Cohen, & Brownell, 1999; Francis et al., 2001), which in turn leads to child weight-focused restrictive feeding practices (Crouch et al., 2007) and then to prospective child weight gain (Faith et al., 2004) (see Figure 1). Thus, a mother's own concern about her weight and body dissatisfaction may lead her to diet and also to be concerned about her child's weight, contributing to her using weight-focused restrictive feeding practices with the unintended effect of reducing a child's food related self-regulation and, subsequently, child weight gain. However, to date, there have been no prospective explorations of these relationships. The present study therefore sought to explore this model.

Our principle aim was to test our model, prospectively predicting child weight gain, in which we hypothesized that the relationship between maternal body dissatisfaction at Time 1 and child weight gain at Time 2 would be mediated by Time 1 maternal restrictive eating, concern regarding the child's weight and restrictive feeding practices (Figure 1).

Methods

Participants

As mothers' influence over their children's eating behavior may be presumed to be the strongest when children are very young, we conducted the study among a sample of 2- year-olds and their mothers. Participants were 220 mother-child dyads for which mothers completed identical questionnaires at baseline and 1 year later. At baseline, children (103 males and 117 females) were aged between 1.5 and 2.5 years (mean age = 2.03, *SD* = 0.37) and on average mothers were 35 years old (*SD* = 0.46). Mothers were included in the sample if they could read and understand English, were over 18 years old and had a child between 1.5 and 2.5 years old who had no food allergies, intolerances or deficiencies which interfered with their eating patterns or food intake. Mothers, on average, were well educated (74% had completed a university course), were born in Australia (76%), and worked as stay at home parents, (38%) or the skilled worker or administrative level (26%). Only 2.7% of the sample was very low income (under $A20,000), 22.5% reported a low income ($A20,001 to $A60,000), 37% a medium income ($A61,000 to $A100,000), and 37.8% a high income ($A101,000 or over).

Procedure

Approval to conduct this research was obtained from the La Trobe University Human Ethics Committee. Local playgroups within greater metropolitan Melbourne (Victoria) were approached. When invited, a researcher briefly presented information about the study to mothers and interested mothers were recruited. Some additional participants were recruited through maternal and child health centers, leaflets, advertisement in local papers and word of mouth. Written consent was obtained and children's height and weight were measured. Parents completed a questionnaire package

at baseline (Time 1), returned in a reply paid envelope. At one-year follow-up, on average 52 weeks later (Time 2), researchers obtained child height and weight. Mothers received a $10 gift card for participation on each occasion.

Measures

Anthropometric Assessment. Child height (to the nearest .1 of a centimetre) and weight (to the nearest .1 of a kilogram) were obtained. At Time 1, all children were measured by researchers using the same scales. At Time 2, 64.1% (*n*= 140) were weighed by researchers but due to resource limitations, 35.9% (*n* = 78) were not. In the latter cases, maternal health records were used if the child had been measured within the last 3 weeks or parent report was used as last resort. Children were lightly clothed for all measurements with shoes removed. In line with the CDC guidelines (Kuczmarski et al., 2000) BMI categories were defined as underweight (BMI < 5^{th} percentile), healthy weight range (5^{th} percentile ≤ BMI < 85^{th} percentile), overweight (85^{th} percentile ≤ BMI < 95^{th}) and obese (BMI ≥ 95^{th} percentile). For children aged two and above (56.2% of our sample), children's BMI was then calculated and converted into a standardized *z*-score ("Medicine Co. Children's BMI-percentile-for-age Calculator [online calculator]. Retrieved from http://www.bcm.edu/cnrc/bodycomp/bmiz2.html") adjusting for age and gender (referred to here as BMI*z*) based on the population growth references provided by the National Center for Health Statistics. As the use of length rather than height is recommended for children under the age of 2 years (Mei et al., 2002), we corrected for this by adding 0.7cm to the height of children and using the WHO calculator to calculate BMI*z* scores for the children under the age of two (World Health Organization, 2011).

Maternal Variables

Maternal BMI

Maternal Time 1 self-reported height and weight were used to calculate maternal BMI. Self-report data have been shown to be correlated strongly with objective measures despite a consistent trend towards under-estimation (Gorber, Tremblay, Moher, & Gorber, 2007)

Body dissatisfaction

Body dissatisfaction was assessed at Time 1 using the 5-item Weight Concern subscale of the Eating Disorders Examination Questionnaire (Fairburn & Beglin, 1994), which is a widely used questionnaire assessing body dissatisfaction and disordered eating behaviors that has been validated in community women, including in Australia (Mond, Hay, Rodgers, Owen, & Beumont, 2004). Items assess the frequency with which the participant has experienced weight concerns over the last 28 days on a scale ranging from 0 (*never*) to 6 (*everyday*). An example item is: "Have you had a strong desire to lose weight?" Our sample's Cronbach's α was .80.

Maternal concern of child weight

Concern regarding child weight was assessed at Time 1 using the 3-item Concern over Child Weight subscale of the Child Feeding Questionnaire (CFQ; Birch et al., 2001) which has been demonstrated to have good validity, reliability (Kröller & Warschburger, 2008) and internal consistency (Faith et al., 2004; Geng et al., 2009) in children aged 2 to 11 years. This subscale assesses the degree to which parents are preoccupied by the idea that their child might gain weight. Items are rated on a Likert scale ranging from 1 (*disagree*) to 5 (*agree*), with high scores indicating high degrees of concern. An example

item is: "How concerned are you about your child having to diet to maintain a desirable weight?" In our sample Cronbach's α was .78.

Maternal dietary restraint

Maternal dietary restraint was assessed at Time 1 using the 5-item Restraint subscale of the Eating Disorders Examination Questionnaire (Fairburn & Beglin, 1994). Items assessing the frequency with which participants engaged in restrictive eating behaviors such as limiting food intake or avoiding certain foods over the last 28 days are rated from 0 (*never*) to 6 (*everyday*). An example item is: "Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight?" In our sample Cronbach's α was .70.

Child weight-focused restrictive feeding

Child weight-focused restrictive feeding was measured at Time 1 using the 7-item Restriction for Weight Control subscale from the Comprehensive Feeding Practices Questionnaire (CFPQ; Musher-Eizenman & Holub, 2007). This scale assesses parents' restriction of all types of food explicitly in order to control their child's weight. We chose to use this subscale as opposed to the CFQ restriction subscale partly, as previously discussed, due to concerns regarding the construct assessed by the CFQ restriction subscale, and also due to previous reports of low internal reliability for this scale (Snoek, Sessink, & Engels, 2010). The CFPQ items are rated from 1(disagree) to 5(agree), and an example item is: "I give my child small helpings at meals to control his/her weight". This subscale has been shown to possess good internal reliability, and convergent validity with parents' concern for their child being overweight in samples of children aged 2 to 8 years old (Musher-Eizenman & Holub, 2007). In our sample Cronbach's α was .78.

Statistical Analyses

Two outliers were removed from the analysis. A BMI*z* change score was calculated by subtracting Time 2 BMI*z* from Time 1 BMI*z*. As certain variables were not normally distributed, we used non-parametric equivalents for testing differences in means and our initial correlation analysis was conducted using Spearman's coefficient. Path analysis was conducted in AMOS 19.0 using maximum likelihood estimation. The fit proposed model was evaluated using a number of goodness of fit indices, including the Chi-squared test (criterion: $p > .05$); Goodness of Fit Index (GFI, criterion > 0.95), Comparative Fit Index (CFI, criterion > 0.95), and the Root Mean Square Error of Approximation (RMSEA, criterion < 0.06) (Browne & Cudeck, 1993; Hu & Bentler, 1999). The Bollen-Stine bootstrapping procedure (Bollen & Stine, 1992) was used as a supplemented test to conventional chi-square test of fit to test the hypothetical model. Additional pathways were included in the model if the theoretical framework predicted them. Multiple mediation in the model was formally tested using Boostrapping.

Results

Participant characteristics

The mean self-reported maternal BMI was in the healthy range with 2.9% of mothers in the underweight range, 65.2% of mothers in the healthy weight range, 22.9 % in the overweight range and 9% in the obese range. These proportions somewhat higher than national data for women in this age group (Australian Bureau of Statistics, 2009). Furthermore, 35% ($n = 72$) mothers reported being pregnant or having recently been pregnant, which may have led to an overestimation of rates of overweight. At Time 1,

6.1% of children were underweight (BMI < 5th percentile), 64.8% were in the healthy weight range (5th percentile ≤ BMI < 85th percentile), 18.3 % were overweight (85th percentile ≤ BMI < 95th) and 10.8% were obese (BMI ≥ 95th percentile), while the remainder were in the healthy weight range. Descriptive statistics for BMI*z* and maternal variables are included in Table 1. There was no difference in BMI*z* change score between children measured by researchers and those who were not (measured mean = -0.18, *SD* = 1.16; not measured mean = -0.20, *SD* =1.14, $t(218)$= -0.12, p=.90). Furthermore, the variance ratio F-test indicated no difference between the variances in BMI*z* change score between children who were measured by researchers and those who were not, p> .05. Over the course of the study, the mean change in child BMI*z* was mean = -.16, *SD* = 1.15, ranging from -5.33 to 2.46.

In order to explore differences between mothers of male and female children, we tested for difference in baseline maternal BMI, body dissatisfaction, maternal dietary restraint, child weight concern, and child weight-focused restrictive feeding. Findings revealed that mothers of male and female children differed only in terms of child weight concern (p<.001), with mothers of male children reporting lower levels of concerns compared to mothers of female children.

Bivariate correlations amongst variables

Prior to testing the model, correlations between the variables were explored (Table 2). Maternal BMI was positively correlated with maternal body dissatisfaction (p<.001), child baseline BMI*z* (p<.01), and child follow up BMIz, (p<.001). Maternal body dissatisfaction was correlated positively with both maternal dietary restraint

(p<.001) and child weight concern (p<.01). Child weight concern was correlated positively with both child baseline BMIz (p<.001) and child follow up BMIz (p<.001). Child weight-focused restrictive feeding was correlated positively with child weight concern (p<.01), and child baseline BMIz (p<.05), but the relationship with maternal dietary restraint failed to meet significance (p = .104). In addition, there was no significant correlation between child weight-focused restrictive feeding and child BMIz change as would have been expected. Maternal dietary restraint however, was associated with upward change in child BMIz scores (p = .005), and at the trend level with follow up child BMIz (p = .096) but not baseline child BMIz.

In addition we explored the relationship between study variables and parental income and education. Higher baseline maternal BMI was associated with lower parental income (ρ = -.18, p<.05) and lower education (ρ = -.19, p<.05). Furthermore, child weight-focused restrictive feeding displayed a small correlation with parental education (ρ = .15, p<.05).

Test of proposed model

A test of the proposed model (described in Figure 1) revealed that it was a moderate fit to the data, χ^2 (9) = 9.81, p = .367, Bollen-Stine bootstrap p = .333, GFI = .984, CFI = .993, RMSEA = .02. An examination of the modification indices indicated that including an additional pathway from maternal dietary restraint to child BMIz change would further improve the fit. As it is theoretically possible for maternal dietary restraint to effect child BMIz change without being mediated by restrictive feeding practices this pathway was added. The new model revealed a good fit to the data, χ^2 (8) = 3.63, p

=.888, Bollen-Stine bootstrap p = .826, GFI = .994, CFI = 1.000, RMSEA = .000 (Figure 2). The model explained 21% of the variance in maternal body dissatisfaction, 23% of the variance in maternal dietary restraint, 2% of the variance in child weight concern, 8% of the variance in child weight-focused restrictive feeding practices, and 3% of the variance in child BMI$_z$ change. Most of the pathways were significant, with the standardized coefficients indicating small effects sizes. However, neither the pathway from maternal dietary restraint to child weight-focused restrictive feeding (p= .124), nor the one between child weight-focused restrictive feeding and child BMI$_z$ change (p=.349) were significant.

We then investigated the indirect effects of body dissatisfaction on child weight-focused restrictive feeding via both maternal dietary restraint and child weight concerns (Hayes, 2009). Results based on 5,000 bootstrapped samples revealed a significant indirect effect of maternal body dissatisfaction on restrictive child-feeding through child weight concerns, B = .014, SE = .092, 95% bias-correction and accelerated (BCa) CI [.00, .04]. However, the indirect effect through maternal dietary restraint just failed to meet significance as the confidence interval included 0, B = .024, SE = .016, 95% BCa CI [-.004, .057]. Furthermore, the examination of the contrasts revealed no significant difference in magnitude of the indirect effects through maternal restriction and child weight concerns, 95% BCa CI [-.021, .049]. The findings, therefore, supported an indirect effect of maternal body dissatisfaction on restrictive feeding practices through child weight concern.

Discussion

Whilst numerous studies have examined relationships between weight concerns and dieting in mothers and body image and eating disordered behavior in their children (Wertheim, Martin, Prior, Sanson, & Smart, 2002; Wertheim, Mee, & Paxton, 1999), ways in which these factors may be related to other variables such as BMI outcomes in very young children have not been closely examined. As the transmission of body image and eating-related attitudes and behaviors from mothers to children may vary according to child's age and the mother's control over the food environment, it is essential to consider these relationships in very young children, with age-appropriate outcomes. Using prospective data, we examined a mediation model of relationships between maternal body dissatisfaction, dietary restraint, concern about the child's weight, child weight-focused restrictive feeding practices, and change in child BMI. Although the proposed model showed a moderate fit to the data an important path was not well supported, that between the use of restrictive feeding practices and change in child BMI*z*. Instead, there was stronger support for a path directly between maternal dietary restraint and BMI*z* change.

Other longitudinal studies have also previously failed to reveal a relationship between restrictive feeding practices and change in child BMI*z* (Campbell et al., 2010; Farrow & Blissett, 2008). It may be that the restriction of high-fat and high-calorie foods in itself is a healthy behavior and not associated with weight gain in very young children. Another possibility is that restrictive feeding practices may slow weight gain in young children. It may also be that children this young lack the autonomy to increase their intake of the foods rendered desirable by the restrictive feeding practices. Furthermore, it

has been argued that measures of restrictive feeding practices may offer a narrow conceptualization of restriction, and that it is important to know exactly which behaviors are being measured (Ogden, Reynolds, & Smith, 2006). In particular, items do not clarify whether high-fat foods are being *denied to* the child or whether the child is unaware that they are not on offer. In the latter case it is less likely a child would develop a preference for the foods being restricted. Children as young as 3 years old have been shown to be capable of describing parental restriction of certain foods (Fisher & Birch, 1999).

Our finding that maternal dietary restraint predicted child BMI*z* change is in line with previous reports of maternal dietary restraint being associated with 5-year olds' capacity to regulate caloric intake in short-term laboratory based experimental studies (Birch & Fisher, 2000). High levels of maternal dietary restraint may lead mothers to perceive restricted foods as highly desirable, indeed there is some evidence of heightened reward-related brain activity in response to food stimuli among individuals with high levels of restraint (Burger & Stice, 2011). Furthermore, previous research has found that child weight gain was predicted by the use of food as a reward by mothers (Campbell et al., 2010). It may be, therefore, that mothers who perceive foods they are trying to limit, typically high-calorie foods, as particularly desirable and rewarding, may transmit this concern to their children via both their attitudes and their feeding practices. As young children have not yet developed the cognitive capacities necessary to exercise restraint in the way their mothers do, this may lead them to consume more of these foods and thus gain weight. Furthermore, young children whose mothers experience high levels of body dissatisfaction and disordered eating are likely to grow up in an environment in which such attitudes and behaviors are modeled and transmitted (Rodgers & Chabrol, 2009).

Overweight and obesity at a young age in this type of environment is therefore likely to lead to body dissatisfaction and disordered eating in the child as well (Ludwig, 2007).

While we proposed weight-focused restrictive feeding practices to be the mechanism through which maternal restraint is associated with childhood overweight, other authors have proposed the existence of other mechanisms to account for this association. For example, biological theories have highlighted the relationship between the lack of breast-feeding and obesity risk in young children (Arenz, Rückerl, Koletzko, & Von Kries, 2004). Mothers with high levels of eating concerns have been shown to be less likely to breast-feed their children (Patel, Wheatcroft, Park, & Stein, 2002), which might then account for the relationship between maternal restraint and childhood overweight. Genetic transmission of the tendency to store fat tissue have also been well established (Loos & Bouchard, 2003) and it is possible that mothers who gain weight easily are also more likely to diet as well as have children with a tendency to gain in BMI. However, a direct path between maternal BMI and child BMI*z* change was not indicated by our modeling. Another possibility is that maternal restraint was associated with a range of other less healthy eating habits such as consumption of high fat foods and the child was also being fed such food. In addition, our model failed to take into account a number of other variables which may have shed further light on these relationships such as the mode of early feeding and the rate of weight gain over the first year. More research is required to understand the mechanism by which maternal dietary restraint is related to child BMI*z* change at this early age.

Our findings suggest an indirect effect of maternal body dissatisfaction on weight-focused restrictive feeding practices via concern regarding the child's weight and, to a

lesser extent, maternal dietary restraint. This finding is consistent with some (Gray et al., 2010) but not all (Francis & Birch, 2005) previous studies, and highlight the role of maternal body image and eating concerns in shaping their children's food-environment, eating behaviors, and weight outcomes.

Overall, the present findings and extant literature suggest that the relationship between maternal body dissatisfaction and weight-focused restrictive feeding practices is somewhat complex and conditioned by other variables including disordered eating behaviors, concern regarding the child's weight but also perhaps the child's actual BMI as well as the mother's (Gray et al., 2010).

Our model explained 3% of the variance in child BMI*z* change. While this is somewhat small, perhaps highlighting the large number of other genetic and environmental influences on child weight in early infancy (McPhie et al., 2012; Rhee, 2008; Wardle, Carnell, Haworth, & Plomin, 2008), the clarification of such causal pathways leading to child weight gain is of crucial importance in view of the increasing prevalence of child obesity (Crouch et al., 2007) and with a view to identifying targets for effective prevention interventions. Our findings suggest that programs which jointly address maternal body dissatisfaction and unhealthy dieting, while providing guidance regarding healthy feeding and weight management practices for young children might have a high potential for preventing increases in child BMI*z*.

Limitations to this study include the use of self-report measures for assessing maternal body dissatisfaction, eating concerns and feeding practices as well as, on occasion at time 2, child BMI. Furthermore, our study included only 2 time points therefore directional pathways could be explored only to a certain extent. Finally, our

sample was somewhat more overweight than the national average in 2007 (Commonwealth Scientific and Industrial Research Organisation, 2008), which may limit the extent to which these findings can be generalized. However, it may also be a strength in that it ensures that the high-risk group of interest was well-represented. The high prevalence of tertiary education among the mothers included in our sample constitutes another limit to the generalizability of our findings. Nevertheless, this study was the first to explore mechanisms linking mother's body dissatisfaction and dieting with their child's weight gain and provides important information regarding these pathways. Findings suggest that mothers of young children with high levels of body and eating-related concerns are paradoxically at risk of having their child gain weight more rapidly at a young age, and thus increasing their child's risk for similar body and eating-related concerns. Future research exploring these pathways over a longer time period may help to clarify how these relationships evolve over time, and in particular influence the development of children's own body and eating related concerns. Furthermore, early interventions may help mothers to implement more effective feeding practices as well as decreasing their own weight-related concerns.

Competing interests:

The authors declare that they have no competing interests.

Authors' contributions:

SP led the project, initial design and grant application and data collection. She also helped draft the manuscript. EW, HS, KC and KG participated in the design of the study and advised on the study's rationale and coordination and provided feedback on the manuscript. SM helped coordinate data collection and management. RR performed the statistical analysis and drafted the manuscript. All authors provided feedback about, and approved the final manuscript.

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Table 1

Range, Mean and Standard Deviation for Study Variables at Time 1 for Girls (n = 118) and Boys (n = 100), Mean Age = 2.03, SD = 0.37.

	Range	Mean (*SD*) or % (*n*)
Girls (*n* = 118)		
Underweight		5.1% (*n* = 6)
Healthy weight		68.2% (*n* = 81)
Overweight		15.9% (*n* = 19)
Obese		10.2% (*n* = 12)
Boys (*n* = 100)		
Underweight		6% (*n* = 6)
Healthy weight		60.9% (*n* = 61)
Overweight		21.9% (*n* = 22)
Obese		11.1% (*n* = 11)
Maternal BMI		23.93 (4.05)
Child BMIz		.29 (1.18)
Body dissatisfaction	0-6	1.37 (1.25)
Child weight concern	1-5	1.66 (.91)
Maternal dietary restraint	0-6	1.02 (1.10)
Child weight-focused restrictive feeding	1-5	1.87 (.50)

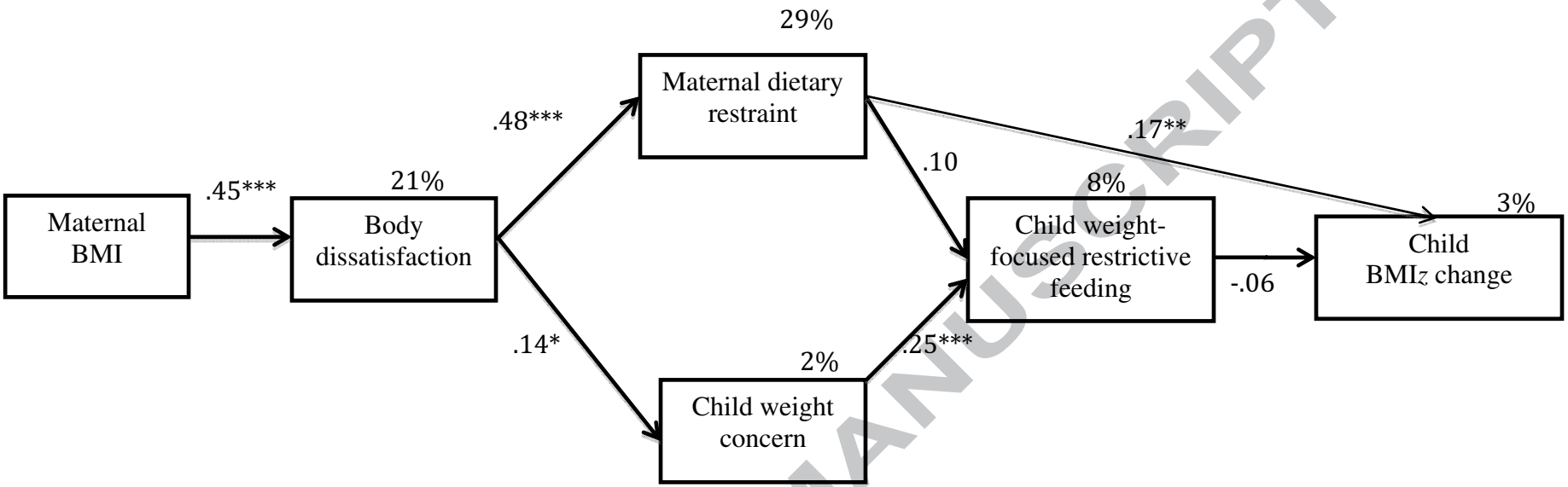
Table 2

*Spearman Correlations between Study Variables Over a 1-year Interval, N = 218, mean age at Time 1 =*2.03 *years.*

	Body dissatisfaction	Child weight concern	Maternal dietary restraint	Child weight-focused restrictive feeding	Child baseline BMI*z*	Child follow up BMI*z*	BMI*z* change
Maternal BMI	.50***	.10	.32***	.00	.19**	.22***	.06
Body dissatisfaction		.20**	.53***	.05	.08	.08	.04
Child weight concern			.07	.28**	.34***	.24***	-.11
Maternal dietary restraint				.12	-.07	.11¶	.20**
Child weight-focused restrictive feeding					.14*	.08	-.05

*p<.05, **p<.01, *** p<.001, ¶ p<.10

Note: Child BMI is derived from measure height and weight using CDC references; mothers BMI is calculated from self-report data; Body dissatisfaction: Weight Concern subscale of the Eating Disorders Examination Questionnaire (Fairburn & Beglin, 1994); Child weight concern: Concern over Child Weight subscale of the Child Feeding Questionnaire (Birch et al., 2001); Child weight-focused restrictive feeding: Restriction for Weight Control subscale from the Comprehensive Feeding Practices Questionnaire (Musher-Eizenman & Holub, 2007).



*p<.05, **p<.01, ***p<.001

Figure 1: Proposed (in bold) and Final Model with Standardized Path Coefficients *(β)* and Explained Variance.

Highlights:

- We tested a model predicting child restrictive feeding and change in BMI
- Maternal dieting mediates the relationship between maternal body dissatisfaction and change in child BMI*z*
- Concern about child weight mediates the relationship between maternal body dissatisfaction and restriction
- Restrictive feeding practices did not predict change in child BMI*z*