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# Pumpkin is “yucky”!: A prospective study of overt and covert restriction in the development of young children’s food preferences

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**Abstract**

The aim of the study was to investigate maternal feeding strategies as prospective predictors of young children's food preferences. Participants were 106 mother – child dyads with data collected when children were aged 4 (Time 1) and then again at 6 years old (Time 2). Mothers completed an initial questionnaire at Time 1 which contained measures of restrictive and covert feeding strategies. Children were interviewed concerning their food preferences and had their height and weight measured at Time 1 and again two years later (Time 2). Longitudinal regression results showed that Time 1 parental restrictive feeding predicted decreased child-reported preferences for fruit and vegetables and increased preferences for salty food and sweets at Time 2. Conversely, Time 1 parental covert control predicted greater child-reported preferences for fruit and vegetables over time. The results provide longitudinal evidence of the negative impact of restrictive feeding, and of the positive impact of covert control, on the development of young children's food preferences.

Childhood obesity presents a significant health risk (Wang & Lobstein, 2006). Although the causes of obesity are complex, a major contributing factor is the overconsumption of food high in fat, salt and sugar, such as most snack foods (Larsen & Story, 2013). Recent data show many young Australian children do not meet the recommended daily intakes of fruits and vegetables (ABS, 2012). Instead, energy dense snack foods make up close to one third of their daily energy intake (ABS, 2012). Children's food preferences, in terms of their food likes and dislikes, are one of the most powerful predictors of their intake (Birch, 1979; Gibson, Wardle & Watts, 1998; Skinner, Carruth, Bounds & Ziegler, 2002; Jaramillo, Yang, Hughes, Fisher, Morales & Nicklas, 2006). These food preferences develop in early childhood and remain relatively stable through later childhood (Skinner et al., 2002), and into adolescence (Northstone & Emmett, 2008) and adulthood (Nicklaus, Boggio, Chabanet & Issanchou, 2004; Mikkilä, Räsänen, Raitakari, Pietinen & Viikari, 2005). In addition, once developed, food preferences are resistant to change (Hawkes, Smith, Jewell, Wardle, Hammond, et al., 2015). Therefore early childhood may represent a sensitive window for establishing preferences for foods that could potentially impact an individual's lifelong health.

Particularly for young children, parents are a critical influence in the development of food preferences and eating patterns (Gregory, Paxton, Brozovic, 2011). Parents use a variety of feeding strategies in order to encourage their children to eat healthily and to restrict their intake of unhealthy foods. Such feeding strategies have been be conceptualised as either 'overt' or 'covert' control (Ogden, Reynolds & Smith, 2006). Overt control strategies include monitoring and restricting the child's food intake and are explicitly communicated between the parent and the child. As such, overt strategies can be easily detected by the child. Many of the existing measures of parent feeding strategies (e.g., Child Feeding Questionnaire: Birch, Fisher, Grimm-Thomas, Markey, Sawyer & Johnson, 2001;

Comprehensive Feeding Practices Questionnaire: Musher-Eizenman & Holub, 2007) are parent reported and address aspects of overt control. The most widely examined parent feeding strategy is restrictive feeding, which involves parents' deliberate attempts to limit the consumption of unhealthy foods, e.g., by forbidding the child to eat sweets (Ogden et al., 2006). Restrictive feeding is most commonly measured by the Restriction Subscale of the Child Feeding Questionnaire (CFQ: Birch et al., 2001). While this has largely been conceptualised as a form of overt control (Yee, Lwin & Ho, 2017), it needs to be acknowledged that some of the items of the Restriction subscale are somewhat ambiguous and may include aspects of control that are covert, as well as overt. Indeed, some factor analyses including the Restriction Subscale have shown that the items do not always hang together well (Boots, Tiggemann & Corsini, 2017; Corsini, Danthiir, Kettler & Wilson, 2008), perhaps reflecting different aspects of parental control.

Nevertheless, in cross-sectional studies, parental restrictive feeding (as measured by the CFQ) has been associated with a number of negative outcomes, including eating in the absence of hunger (Birch & Fisher, 2000), poorer diet quality in terms of higher fat intake (Lee, Mitchell, Smiciklas-Wright & Birch, 2001), greater intake of unhealthy snacks (Boots, Tiggemann & Corsini, 2015), increased preferences for high fat and high sugar foods (Vollmer & Baietto, 2017) and greater child weight in some studies (Joyce & Zimmer-Beck 2009; Musher-Eizenman et al., 2009). Longitudinal studies have shown that parental restriction predicted child weight one year (Rodgers, Paxton, Massey, Campbell, Wertheim et al., 2013) and two years later (Faith, Scanlon, Birch, Francis & Sherry, 2004) and eating in the absence of hunger two years (Fisher & Birch, 2002; Rollins, Loken, Savage & Birch, 2014; Rodgers et al., 2013) and four years later (Birch, Fisher & Davison, 2003). In addition, parental restrictive feeding has been associated with children's food responsiveness and emotional overeating one year (Rodgers et al., 2013) and two years later (Steinbekk, Belsky,

Wichstrom, 2016), as well as disordered eating and weight gain in adolescence (Balantekin, Birch & Savage, 2017). Reviews of existing literature with children aged 4 - 9 years old have concluded that restriction simultaneously promotes overeating when the restricted foods are made more freely available and increases children's preference for the restricted foods, although they also point out that more well designed longitudinal research is needed to fully understand these relationships (Loth, 2016; Ventura & Birch, 2008).

In contrast to global restrictive strategies, covert feeding strategies aim to reduce the intake of unhealthy foods through means that are not communicated directly to the child and therefore remain un-detected by the child (Ogden et al., 2006). In other words, the parent manages the child's food environment, rather than the child directly, by providing primarily healthy foods in the home and avoiding restaurants and cafes that serve unhealthy foods when eating out. A small number of cross sectional studies of school-aged children have shown that covert control is associated with parent reports of lower intake of unhealthy snack foods (Brown & Ogden, 2004; Brown, Ogden, Vögele & Gibson, 2008) and greater fruit consumption (Rodenburg, Kremers, Oenema & van de Mheen, 2013). Two longitudinal studies with pre-school aged children (mean age = 4 years) have shown that covert feeding strategies are associated with parental reports of less unhealthy snack intake (Boots, Tiggemann & Corsini, 2018) and improved diet quality (Jarman, Ogden, Inskip, Lawerence, Baird et al., 2015).

More recently, parental feeding strategies have been conceptualised more broadly to reflect control versus structure in feeding children (Savage, Rollins, Kugler, Birch & Marini, 2017; Rollins, Savage, Fisher & Birch, 2016). Similarly, feeding strategies have been mapped to identify three overarching constructs: coercive control, structure, and autonomy support (Vaughn, Ward, Fisher, Faith, Hughes et al., 2015). Restrictive feeding (as measured by the CFQ) is seen as a form of coercive control, whereas covert control is a form of structure

whereby parents limit access and create predictable routines to organise the child's environment (Rollins et al., 2016). It is argued that structure has a beneficial influence on children's eating because it promotes the development of self regulation resulting in improved overall diet quality (Savage et al., 2017), without any sense of deprivation or emotional angst that may be associated with more coercive feeding strategies. However, the relationship between parental use of structure and the development of children's food preferences has yet to be tested.

More generally, while there is a large amount of research on the effects of restrictive feeding on children's food consumption, there is little on the development of food preferences. Most of this existing research has consisted of short-term experimental studies that have restricted children's access to a specific food (e.g., chocolate Easter eggs) and shown that children's attention toward the restricted food and desire to obtain and consume the restricted food increased (Fisher & Birch, 1999a; Fisher & Birch, 1999b; Jansen, Mulkens & Jansen, 2007; Ogden, Cordey, Culter & Thomas, 2013; Rollins et al., 2014). These studies offer an experimental analogue to the effect of restriction on children's eating behaviour. A broader review of experimental studies of children's eating concluded that restriction serves to increase children's attraction to and preferences for the restricted foods, while simultaneously decreasing preferences for other (healthier) foods (DeCosta, Møller, Bom Frøst, Olsen, 2017). However, none of above studies speaks to the role of parent feeding in the *development* of children's food preferences, which necessarily takes place over time. To our knowledge, there are no longitudinal studies that have investigated the impact of restrictive feeding strategies on children's food preferences.

Thus, the purpose of the present study was to examine two conceptually different parent-feeding strategies in the development of children's food preferences using a longitudinal research design. Importantly, instead of using a parent-reported measure of

children's food preferences (e.g., Fildes, van Jaarsveld, Llewellyn, Fisher, Cooke & Wardle, 2014), we wanted to ask children about their own food preferences. To this end, maternal use of restrictive and covert feeding strategies and children's reported preferences for fruit, vegetables, salty snacks and sweets were examined at two time points separated by approximately two years. Australian statistics show that 41% of young Australian children do not eat the recommended daily amount of fruit, 98% do not eat the recommended daily amount of vegetables, 50% consume sweets daily and 41% eat salty fatty foods daily (Australian National Health Survey: ABS, 2012). As children's acceptance and intake of fruits, vegetables and non-core foods such as salty snacks and sweets are at least in part determined by their food preferences (Mallan, Fildes, Magarey & Daniels, 2016), we chose to examine preferences for these foods. Based on the findings of the previous experimental and cross-sectional studies, we predicted that restrictive feeding would be associated with an increase in children's preferences for salty snacks and sweets and a decrease in preference for fruit and vegetables over time. We predicted the opposite pattern for covert control. We also investigated changes in children's BMI.

## Method

*Participants*

Participants were 106 children (57 girls and 49 boys) and their mothers. They were a subset of an initial sample recruited through 12 kindergartens in South Australia, Australia (*n* = 213; Boots et al., 2018) who had indicated willingness for their child to be followed up two years later when their child was at school. There were no exclusion criteria deployed. Interested mothers were contacted via email two years after the initial study, which was conducted in early 2016. Time 2 data were collected in early 2018. The retention rate at Time 2 was 51%. Attrition analyses showed that mothers who consented for their child to participate in the follow-up were older ($M$ = 36.1, $SD$ = 6.1 vs $M$ = 34.27, $SD$ = 6.5), $t$(102)

=2.15, $p$ = .03, and more likely to have a tertiary education ($M$ = 3.33, $SD$ = .75 vs $M$ = 3.1, $SD$ = .86), $t$(102) =1.96, $p$ =.05, than those who did not consent. They did not differ on socioeconomic status or BMI ($p$s > .34).

*Parent Survey*

The mothers completed a questionnaire at Time 1, entitled "Kids Eating Project". The questionnaire contained measures of parent feeding strategies as outlined below. Demographic information was also obtained. Mothers reported on their own age and the age and gender of their child. Residential postcode and educational attainment were also collected. Socioeconomic status was assigned based on postcode of residence (Australian Bureau of Statistics [ABS]: 2013). Mothers also reported their own height and weight which were used to calculate maternal BMI.

*Parental Restriction*

The Restriction subscale of the Child Feeding Questionnaire (CFQ: Birch et al., 2001) contains 8 items addressing parents' propensity to control child eating by limiting the amount and portion sizes of certain foods, using food as a reward and by monitoring children's intake of certain foods. Exemplar items are, "I have to be sure that my child does not eat too many high-fat foods" and "If I did not guide or regulate my child's eating s/he would eat too many junk foods." Responses are made on a 5-point Likert scale (1 = *disagree*, 5 = *agree*) and summed and averaged to produce a score ranging from 1 to 5, with higher scores indicating greater restrictive feeding. Birch et al. (2001) reported the internal reliability of the original Restriction scale as acceptable (α = 0.73). In the present sample, internal reliability of the Restriction scales was similar (α = 0.71).

*Covert Control*

Covert control was measured by the Covert Control Scale developed by Ogden et al. (2006). This 5-item scale addresses strategies that parents use to control the child's consumption of energy dense food through limiting their exposure to these foods in the child's immediate environment. Items include "How often do you avoid taking your child to places that sell unhealthy food", and "How often do you avoid buying sweets, crisps, biscuits and cakes and bringing them into the home". Higher scores on the covert control measure indicate greater control of the child's environment. The original measure had adequate internal reliability (Cronbach's $\alpha = 0.79$). In the present sample, internal reliability was similar ($\alpha = 0.74$).

*Child Measures*

*Food Preference Interview*

Children's food preferences at Time 1 and Time 2 were measured by the same researcher (first author) by interviewing each child individually in their usual educational setting (Time 1: Kindergarten, Time 2: Primary School). Commonly children's food preferences have been assessed by parent report on their child's food likes and dislikes (Fildes et al., 2014; Howard, Mallan, Bryne, Magarey & Daniels, 2012; Wardle, Guthrie, Sanderson, Birch & Plomin, 2001; Wardle, Sanderson, Gibson, Rapoport, 2001). An alternative technique that allows children to report on their own food preferences (irrespective of reading ability) is by the use of food photographs (e.g., Jaramillo, Yang, Hughes, Fisher, Morales & Nicklas, 2015; Olsen, Kildegaard, Gabrielsen, Thybo & Møller, 2012). Ratings of food photographs have been shown to provide a valid and reliable measure of children's food preferences (Guthrie, Rapoport & Wardle, 2000). In the present study, children were presented with 20 5" x 7" high gloss coloured photographs of individual foods. The foods were presented on a white background, with no serving plate, and were positioned

in the middle of the frame. The foods came from four categories: fruit (apple, pear, bananas, mandarin, strawberry), vegetables (potato, tomato, carrot, green beans, pumpkin), salty snacks (hot chips, chicken nuggets, potato crisps, salty flavoured crackers, pre-packaged crackers and cheese dip) and sweets (chocolate, cupcakes, chocolate chip biscuits, lollies, ice cream in a cone) and were presented in a fixed random order. Food items were selected on the basis of national data of the most commonly consumed foods by Australian children (Australian National Nutrition Survey, CSIRO, 2007). Children were asked to describe each food using one of three responses, 'Yucky', 'Ok', or 'Yummy', which were subsequently coded 1 – 3. Preference scores were then averaged for each category (fruit, vegetables, salty food, sweets), with higher scores indicating greater liking for that food category.

*Weight status*

A trained research assistant measured the child's height and weight at Time 1 and Time 2. Children's standing height was measured to the nearest centimetre using a fixed wall chart and weight was measured to one tenth of a kilogram using an electronic scale without footwear. Because BMI during childhood is age and sex specific, gender specific growth charts were used to calculate BMI z-scores (Kuczmarski, et al., 2000).

*Statistical Analysis*

Statistical analyses were conducted using SPSS v20 (SPSS Inc Chicago). An alpha level of .05 was used for all statistical tests. Correlational analyses were conducted to assess the bivariate cross-sectional associations between the parental feeding strategies and children's snack preferences at both time points. As across time correlations do not of themselves indicate temporal precedence, a series of hierarchical multiple regressions was undertaken to examine whether Time 1 parent feeding strategies predicted change in children's food preferences over time, while controlling for covariates (child age, child

BMIz, parent age, parent education, SES, parent BMI). Separate regressions were conducted for each food category. In each regression, covariates were entered in Step 1, Time 1 food preference (fruit, vegetables, salty snacks, sweets) was entered in Step 2, and the two Time 1 parent-feeding strategies (Restriction, Covert Control) were entered in Step 3. The relevant Time 2 child food preference was the outcome variable.

## Results

*Sample Characteristics*

The sample comprised 106 children (57 girls and 49 boys) and their mothers. The available demographic characteristics are presented in Table 1. At Time 1 children were aged 3 – 5 years old (*M* = 4.80 years, *SD* = 0.43) and mothers had a mean age of 35. 28 years (*SD* = 6.55), with the majority living in two-adult households (84.2%) with two children (55.4%). At Time 2, children were aged 5 – 7 years old (*M* = 6.59, *SD* = 0.49). Participants came from diverse socioeconomic backgrounds, with 46.8% coming from low to middle SES areas (SIEFA deciles 1-7) and 53% coming from high SES areas (decile 8-10).

Based on BMI cut offs (WHO, 1995), the majority of mothers (55.8%) were of normal weight, 6.3% were underweight, 20.0% were overweight and 17.9% were obese. The majority of children at Time 1 were also of normal weight (60.4%) according to the International Obesity Task Force (IOFT: Cole et al., 2007) age and sex specific BMI cut offs, with 16.0% underweight, 17.0% overweight and 6.0% obese.

*Changes over time*

As can be seen in Table 2, sweets were the most liked of all the food categories at both Time 1 and Time 2, with ice cream the universally most liked (98% described it as "yummy"). The vegetable category was the least liked at both time points, with pumpkin the least liked vegetable (91% described it as "yucky" at Time 2). Table 2 also shows that

children's preference for both fruit, $t(106) = 5.28$, $p < .001$, and vegetables, $t(106) = 2.22$, $p = .01$, decreased over time. There were no significant changes over time in children's preferences for salty food or sweets or BMI. All correlations between respective Time 1 and Time 2 variables were moderately positive.

*Associations between parent feeding and children's snack food preferences*

As expected, restrictive and covert feeding strategies were negatively correlated ($r = -.22$, $p < .023$). Table 3 displays the correlations between Restriction and Covert Control and children's preferences for fruits, vegetables, salty snacks and sweets. Within Time 1, more frequent use of restrictive feeding was associated with lower preference for fruits and vegetables. Parental use of covert control was not associated with any children's food preferences. Neither parent feeding strategy was associated with BMI.

Table 3 also shows across time correlations. Time 1 restrictive feeding was associated with lower preference for fruit and vegetables and with higher preference for sweets at Time 2. The converse relationship was evident for covert control, with Time 1 covert feeding associated with higher preferences for fruit and vegetables and lower preference for sweets at Time 2. Parent feeding strategies were not associated with children's preference for salty snacks nor BMI at Time 2.

*Longitudinal tests of parent feeding and children's food preferences*

Table 4 displays the results of the regression analyses predicting Time 2 children's food preferences from Time 1 parent feeding strategies. In general, the covariates had little effect, except for the positive effect of parental education on preferences for fruit and vegetables ($\beta = .30$, $p = .023$; $\beta = .33$, $p = .014$, respectively). As can be seen from Step 3, parent-feeding strategies offered significant prediction for each of the categories of child food preference (all $R^2_{change} > .06$, $F_{\text{change}} > 5.0$, $p < .01$). In terms of unique predictors, preference

for fruit was associated with lower restrictive feeding (β = -.38, $p$ = .000) and higher covert control (β = .46, $p$ = .000). The same pattern emerged for vegetables: preference for vegetables was associated with lower restrictive feeding (β = -.37, $p$ = .000) and higher covert control (β = .38, $p$ = .000). Children's preference for sweets was predicted only by greater restrictive feeding (β = .22, $p$ = .002).

A similar hierarchical regression for child BMI showed no significant overall prediction. In particular, parent feeding strategies were not associated with change in BMI, $R^2_{change}$ = .01, $F_{\text{change}}(2, 103) = 0.59$, $p$ = .55, confirming the results of the correlations presented in Table 3. Neither restrictive feeding nor covert control at Time 1 significantly predicted child BMI at Time 2.

## Discussion

To our knowledge the present study is the first to examine the influence of both restrictive feeding and covert control on the development of children's food preferences over time. The major findings are clear. As predicted, greater use of parental restrictive feeding was associated with decreased preferences for fruits and vegetables and increased preferences for salty food and sweets among children two years later. In addition, covert feeding was associated with increased preferences for fruits and vegetables two years later. In the present study, there was no evidence that either parental feeding strategy influenced change in children's weight.

Our first finding that maternal restrictive feeding at approximately age 4 was associated with greater preference for energy dense (both sweet and salty) foods at approximately age 6 confirms that global parental restriction of energy dense foods increases children's preferences over time for this type of food. This longitudinal finding extends the literature showing the paradoxical effect of this type of parental control to a new but

important outcome, naturalistic food preferences. Our finding is consistent with the results of experimental studies that show that restriction of a particular food increases children's preference for that food in the laboratory (Fisher & Birch, 1999a; Jansen et al., 2007; Ogden et al., 2013). Importantly, not only did we show that child preferences for energy dense salty and sweet foods increased, but we also showed that restrictive feeding had a negative impact on children's preferences for fruit and vegetables. Our longitudinal result contrasts with that of Vollmer and Baietto's (2017) cross-sectional study of children of a similar age, which did not find an effect of restrictive feeding on parent-reported children's fruit and vegetable preferences. The difference may be due to the nature of the reports (parent versus child) or the use of a different specific measure, or perhaps it is the case that preferences for fruit and vegetables take some time to develop. Here, we show that restrictive feeding simultaneously increases preferences for (restricted) unhealthy foods, while decreasing preferences for healthy foods.

As predicted, the specific practice of covert feeding used by parents was beneficial for the development of food preferences, in particular increasing preferences for fruit and vegetables. While covert control can be conceptualised as a type of restriction in that it aims to limit children's intake of 'unhealthy foods', covert control differs from restrictive feeding because it is characterised by controlling the child's environment (whereby parents provide mainly healthy foods and avoid bringing unhealthy foods into the home), rather than directly focusing on the child's eating. Most likely, covert control results in children developing preferences for healthy foods due to exposure to and familiarity with a range of foods in a non-coercive manner, without any sense of the deprivation that seems to eventuate when more controlling feeding strategies are used (Ogden et al., 2006). It is argued that under these circumstances, children develop self-regulation of their eating (Vaughn et al., 2015). It is also likely that the food that parents keep in the house reflects their own food preferences

(Kaar, Shapiro, Fell & Johnson, 2016). Our finding not only adds to previous longitudinal work showing that covert control is prospectively associated with parent-reported beneficial outcomes such as children consuming less unhealthy and more healthy snacks (Boots et al., 2018) and improved overall diet quality (Jarman et al., 2015), but also extends these findings to children's own reports of their preferences for fruit and vegetables. Accordingly, the finding adds to the cumulating evidence that covert control presents a positive and effective feeding strategy for parents to use.

Although we have shown that parental restrictive and covert feeding are associated with children's food preferences, here we showed no prediction of BMI by either feeding strategy. It is likely that, although children's food preferences are a major predictor of diet quality and dietary intake (Birch, 1979; Gibson et al., 1998; Skinner et al., 2002; Jaramillo et al., 2006), resulting changes in weight occur more slowly. As food preferences remain relatively stable over time and carry into adulthood (Hawkes et al., 2015), the associated effects of early feeding strategies used by parents may have greater ramifications as children grow older and develop potential lifelong eating habits. Independent of weight, the consumption of fruit and vegetables in adulthood decreases the risk of coronary heart disease, ischemic stroke, some cancers and neurodegenerative diseases such as Parkinson's and Alzhiemer's (Yahia, 2017). On the other hand, the consumption of energy dense sweet and salty unhealthy foods is associated with chronic disease, leading to premature mortality in adulthood (Cecchini et al., 2010). Therefore, developing preferences for fruit and vegetables at a young age may have associated long-term health outcomes for individuals.

The present study has a number of methodological strengths. First, rather than examining children's food preferences at a single time point, the current study examined the relationship between parent feeding strategies and children's food preferences over a reasonable length of time, two years. Second, children were individually interviewed about

their food preferences rather than relying on what parents report, as in the single existing cross sectional study (Vollmer & Baietto, 2017). In addition, the study assessed preferences for a range of foods of different types, and included both ('healthy') fruit and vegetables and ('unhealthy') salty and sweets foods. Finally, our research design allowed the two parental feeding strategies to be examined together and showed that both contribute to (offer unique prediction of) children's food preferences.

The findings from the present study have important practical implications. The contemporary environment, which is saturated with palatable, unhealthy foods that are cheap to buy, presents a major challenge for parents in attempting to establish healthy eating patterns in their young child. Under these circumstances, intuitively it may make sense for parents to actively try to shape children's preferences (and associated consumption) away from unhealthy foods to more healthy foods. In doing so, parents may impose restrictions on the intake of unhealthy foods, such as refusing junk food requests and telling the child that they can only eat a certain amount of sweets. The findings presented here suggest that this type of parental control actually increases children's preference for unhealthy foods and decreases their preference for healthy foods over the longer term. Therefore, parents should be dissuaded from using restrictive feeding strategies and instead be encouraged to use alternative feeding strategies, such as covert control. The findings also have broader ramifications for public health. In the present sample as a whole, although moderately correlated over time, preferences for fruit and vegetables decreased over the two-year period examined, from age four to age six. This is consistent with Australian food intake data; 41% of young children aged between 4 years and 8 years old do not eat the recommended daily amount of fruit, and 98% of young children do not eat the recommended daily amount of vegetables (National Health Survey: ABS, 2012). Arresting this decline in children's

preferences for fruit and vegetables is clearly a vital goal toward improving the health of Australian children.

As with all research, the current study contains some limitations that need to be acknowledged. First, the informants were mothers and not fathers or other salient caregivers. Those mothers who consented to their child participating in the follow up were also older and more educated than the initial sample, indicating some degree of self-selection bias. Second, there are other factors that may affect the development of children's food preferences that were not included, such as parental modelling, parents' own food preferences, and child eating characteristics (e.g., food neophobia, food responsiveness) which have previously been shown to influence the development of children's food preferences in cross-sectional studies (Skinner et al., 2002; Fiese & Jones, 2012; Blissett et al., 2016; Wardle et al., 2005). Third, we used only two well established measures of parental feeding. Future research might include a greater range of parent feeding measures, as well as measures of children's perceptions of their parents' feeding strategies. Fourth, we had no measure of dietary consumption. Although food preferences are shown to be a major predictor of intake (Skinner et al., 2002), future longitudinal studies might track both children's food preferences and consumption. Fifth, it is important to note that longitudinal studies are always limited to the portion of the life span examined, in this case from approximately age 4 to age 6 years, and that relationships may not hold at other time points. In particular, we do not have information on the factors that determine initial parent feeding strategies at an earlier age.

Despite the limitations, the current study has contributed to our understanding of the role of parental feeding strategies in the development of children's food preferences over time. The findings clearly show that the use of global restrictive feeding by parents has a detrimental effect on the development of children's preferences for fruits and vegetables, while increasing children's preferences for sweet and salty snack foods. The results also

show that the specific practise of covert feeding has positive influences on children's food preferences over time. At a practical level, the findings can usefully inform advice given to parents about how to foster healthy food preferences in their children.

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Table 1. Descriptive characteristics for mothers and children (N = 106)

| Characteristics | % | Mean (SD) |
|---|---|---|
| **Mothers (Time 1)** | | 35.28 (6.55) |
| Age | | |
| Number of children | | 2.10 (0.82) |
| Education | | |
| Some university/completed university | 63.2% | |
| Technical or vocational school | 22.4% | |
| Some high school/completed high school | 9.0% | |
| BMI weight category* | | |
| Underweight | 6.3% | |
| Normal | 55.8% | |
| Overweight | 20.0% | |
| Obese | 17.9% | |
| Number of adults in the home | | |
| One | 7.0% | |
| Two | 84.0% | |
| SES** | | |
| Low (1-4) | 36.8% | |
| Mid (5-7) | 10.2% | |
| High (8-10) | 53.0% | |
| **Child** | | |
| Gender | | |
| Male | 46.3% | |
| Female | 53.7% | |
| Child's Age | | |
| Time 1 | | 4.80 (0.43) |
| Time 2 | | 6.59 (0.49) |
| Child BMI | | |
| Time 1 | | 15.80 (2.38) |
| Time 2 | | 15.89 (2.78) |

*BMI weight category for Adults based on WHO weight categories; underweight <18.50, Normal weight 18.50-24.99, Overweight BMI >25.0, Obese >30.0

**SES = Socioeconomic status from SIEFA index of relative disadvantage based on residential postcode

Table 2. Means (*SDs*), *t*-values, and correlations for child food preferences and BMI at Time 1 and Time 2

| | Time 1 | Time 2 | *t* | Correlation |
|---|---|---|---|---|
| *Preference*[a] | | | | |
| Fruit | 2.43 (0.47) | 2.17 (0.57) | 5.28** | .54** |
| Vegetable | 2.11 (0.59) | 1.99 (0.63) | 2.22* | .60** |
| Salty Snacks | 2.70 (0.37) | 2.71 (0.37) | 0.53 | .77** |
| Sweets | 2.91 (0.21) | 2.88 (0.27) | 1.38 | .62** |
| BMI | 15.80 (2.38) | 15.89 (2.78) | 0.36 | .53** |

* $p < .05$ ** $p < .001$

[a] Scored on a three point scale 1= Yucky, 2 = Ok, 3 = Yummy; range 1-3.

Table 3. Correlations between parent feeding strategies, child food preferences and BMI

| | Time 1 Parent Feeding Strategy | |
|---|---|---|
| | Restriction | Covert Control |
| *Fruit* | | |
| Time 1 | -.21* | .11 |
| Time 2 | -.57** | .58** |
| *Vegetables* | | |
| Time 1 | -.22* | .09 |
| Time 2 | -.57** | .52** |
| *Salty Snacks* | | |
| Time 1 | .03 | -.07 |
| Time 2 | .18 | -.17 |
| *Sweets* | | |
| Time 1 | .02 | -.14 |
| Time 2 | .26** | -.20* |
| *BMI* | | |
| Time 1 | .06 | .01 |
| Time 2 | -.04 | -.02 |

* $p < .05$ ** $p < .001$

Table 4. Results for hierarchical regression analyses predicting Time 2 child food preference from Time 1 parent feeding strategies

| | Food Preferences | | | |
|---|---|---|---|---|
| | Fruit | Vegetables | Salty Snacks | Sweets |
| | β | β | β | β |
| Step1: Covariates | | | | |
| Child Age | -.03 | -.03 | -.25 | -.20 |
| Child BMIz | .10 | .10 | .07 | .04 |
| Parent Education | .30* | .33* | .12 | .06 |
| SES | -.02 | -.08 | -.08 | -.02 |
| Parent BMI | .01 | -.12 | -.02 | -.04 |
| $R^2_{change}$ | .08 | .12 | .04 | .04 |
| $F_{change}$ | 1.55 | 2.38* | 0.68 | 0.66 |
| Step 2: Time 1 Preference | | | | |
| Food Preference | .53** | .56** | .76** | .66** |
| $R^2_{change}$ | .24 | 0.28 | .54 | .42 |
| $F_{change}$ | 31.73** | 40.35** | 74.39** | 66.49** |
| Step 3: Parent Feeding Strategy | | | | |
| Restriction | -.38** | -.37** | .12 | .22* |
| Covert Control | .46** | .38** | -.10 | -.06 |
| $R^2_{change}$ | .39 | .32 | .06 | .06 |
| $F_{change}$ | 58.16** | 47.41** | 6.05** | 5.05* |

*$p$ <.05, **$p$ <.01