

Abstract

Parental feeding practices and children's eating behavior are consistently related to childhood obesity. However, it is not known whether parents' feeding practices predict obesogenic eating behavior or *vice versa*. In a Norwegian cohort (n=797) it was found that (1) greater parental use of food as a reward (instrumental feeding) when children were six predicted increased (a) emotional overeating and (b) food responsiveness, whereas (2) greater parental encouragement to eat forecasted increased enjoyment of food two years later. (3) No evidence of child effects emerged. Although children's eating behavior is relatively stable and established at an early age, findings suggest that parental feeding practices can serve as targets of intervention to prevent the development of obesogenic eating behavior.

Children are born with an ability to self-regulate their intake of food (Birch & Deysher, 1986; Fomon, Filer, Thomas, Anderson, & Nelson, 1975), an ability that seems to decrease with age (Johnson & Taylor-Holloway, 2006). Indeed, as children grow their eating is increasingly shaped by external factors. Parents are presumed to be the most powerful socialization agents affecting young children's eating behavior (Savage, Fisher, & Birch, 2007). More specifically, parents are the chief providers and the main "gatekeepers" of food (Cullen et al., 2003; Ventura & Birch, 2008): they model eating behavior (McClain, Chappuis, Nguyen-Rodriguez, Yaroch, & Spruijt-Metz, 2009; Ventura & Birch, 2008), and affect their children's eating through parenting and feeding styles (Ventura & Birch, 2008; Vollmer & Mobley, 2013).

Normal development of eating behavior is important in order to sustain a healthy weight throughout the lifespan (Gahagan, 2012). According to a recent review, more than one of every three American children is overweight or obese (Ogden, Carroll, Kit, & Flegal, 2014), and corresponding numbers are reported from European countries, with rates ranging from 18-57% (Wijnhoven et al., 2014). Given that obesity is related to impaired health (Reilly, 2005; Russell-Mayhew, McVey, Bardick, & Ireland, 2012) and tends to persist from childhood into adulthood (Singh, Mulder, Twisk, van Mechelen, & Chinapaw, 2008), it is imperative to understand the determinants of children's weight. Eating behavior influences energy intake and thus weight through choices of type and amount of food. As parental feeding practices are potentially modifiable risk-factors of unhealthy eating behavior in children, exploring the prospective relation between parenting practices and children's eating is of importance (Rodgers et al., 2013). Notably, developing normal eating behavior is not only important in order to obtain and maintain a healthy weight, but might also decrease the risk for eating disorders, because disturbances in eating behavior are central characteristics of

such disorders (Geraciotti & Liddle, 1988; Heaner & Walsh, 2013; Stice, Presnell, & Spangler, 2002).

It is generally assumed that parental feeding practices contribute to the intergenerational transmission of obesity. Ventura and Birch's (2008) review of relevant studies highlighted important methodological limitations of the relevant research precluding such causal inference, most notably the reliance on cross-sectional designs, absence of measures of child eating and failure to take into account confounding factors that could operate as unmeasured "third variables" (e.g., parental BMI and socioeconomic status). Given the possibility that both children's weight and eating behavior might influence parents' feeding practices, available research has also not been positioned to evaluate reciprocal processes linking the parents' feeding practices and children's eating behavior. Given repeated measurements of both constructs, along with the inclusion of potential confounding factors, the current longitudinal research is positioned to overcome these limitations.

The present research is also positioned to identify parent-feeding and child-eating processes that could limit excessive weight gain in an age period shown to be of particular importance for the development of obesity. BMI tends to decrease after the first two years of life, reaching its nadir between 5 and 7 years, after which it increases again (i.e., the adiposity rebound). The earlier this rebound occurs and the greater the rate of weight increase characterizing it, the greater the risk of a child being overweight or obese (Taylor, Grant, Goulding, & Williams, 2005). Because research suggests that slowing weight gain during this rebound could prevent later obesity (Williams, 2005), there is translational value in identifying factors and processes that could limit excessive weight gain during this period. Because almost all research on parental feeding and child eating has been conducted prior to the adiposity rebound (Faith, Scanlon, Birch, Francis, & Sherry, 2004; Ventura & Birch, 2008), including prospective studies (Rodgers et al., 2013), it has not been in a position to

address this possibility. Thus, the current study aims to examine bidirectional, prospective relations between a range of parents' feeding practices and children's eating behavior in a large and representative sample of Norwegian children followed from age 6 to 8 years, adjusting for children's body mass index (BMI) and parental BMI and family SES.

Eating behavior, feeding practices and weight

Eating behavior is considered to be a biologically influenced disposition toward food (Carnell, Kim, & Pryor, 2012), one which is moderately stable from age 4 to 11 (Ashcroft, Semmler, Carnell, van Jaarsveld, & Wardle, 2008). Eating behavior is multidimensional, with a carefully selected set of behaviors serving as the focus of this inquiry. Food responsiveness, enjoyment of food and emotional overeating are eating behaviors positively associated with overweight (Carnell & Wardle, 2008a; Croker, Cooke, & Wardle, 2011; Jansen et al., 2012; Webber, Hill, Saxton, Van Jaarsveld, & Wardle, 2009) and therefore named *food-approaching* behaviors. Food responsiveness refers to the tendency to eat in response to food cues such as sight and smell of food (Faith, Carnell, & Kral, 2013), whereas enjoyment of food involves a more general interest in food and desire to eat (Wardle, Guthrie, Sanderson, & Rapoport, 2001). Satiety responsiveness, the ability to recognize and adjust eating in response to internal feelings of satiety or fullness, and slowness in eating, on the other hand, are negatively associated with weight in preschool and school-age children (Carnell & Wardle, 2008a; Jansen et al., 2012; Mallan, Nambiar, Magarey, & Daniels, 2014; Spence, Carson, Casey, & Boule, 2011; Webber et al., 2009). Slowness in eating -- i.e., a slow eating rate -- is associated with decreased energy intake (Andrade, Greene, & Melanson, 2008), whereas higher rates of eating increase the risk for childhood overweight (Murakami, Miyake, Sasaki, Tanaka, & Arakawa, 2012). Although other eating behaviors have been identified (French, Epstein, Jeffery, Blundell, & Wardle, 2012) the current inquiry focuses on the above behaviors due to their potential importance in the etiology of obesity.

The term “feeding practices” refers to context-specific, goal-directed behavior or strategies parents employ to control what, when, and how much their children eat (Birch & Fisher, 1998; Ventura & Birch, 2008). In the current work, feeding practices previously shown to influence children’s eating and weight are addressed, specifically control over eating, instrumental feeding and encouragement to eat (Stang & Loth, 2011; Ventura & Birch, 2008). Parental control over eating, such as restriction, is associated with greater child weight (Faith, Berkowitz, et al., 2004; Rodgers et al., 2013; Ventura & Birch, 2008), whereas pressure to eat is associated with lower child body mass index (BMI) (Faith, Scanlon, et al., 2004; Farrow & Blissett, 2008; Ventura & Birch, 2008); notably, the direction of this latter influence remains unclear. For example, do children become obese because parental restriction causes increased food-approaching behavior and thus weight, or is restriction a way parents try to manage childhood obesity?

In the case of parental encouragement or prompting to eat, the findings are contradictory: Cross-sectional studies of children aged 3-7 years document a negative association with weight (Carnell & Wardle, 2007a; Musher-Eizenman, de Lauzon-Guillain, Holub, Leporc, & Charles, 2009; Wardle, Sanderson, Guthrie, Rapoport, & Plomin, 2002), which has also been reported in longitudinal studies of infants and preschoolers (Farrow & Blissett, 2008; Jansen et al., 2014). However, studies of school aged children discern no prospective relation between such feeding practices and adiposity (Spruit-Metz, Li, Cohen, Birch, & Goran, 2006; Webber, Cooke, Hill, & Wardle, 2010b). Studies linking instrumental feeding (e.g., “If you empty your plate you can have ice-cream”) and child weight also yield inconsistent results. Greater parental reliance on rewards to promote child eating has been associated with increased BMIs in children in both cross-sectional and prospective studies (Musher-Eizenman et al., 2009; Rodgers et al., 2013), whereas Carnell and Wardle (2007b) failed to detect such a relation. In summary, both children’s eating behavior and parental

feeding practices are associated with children's weight, although findings are inconsistent and the majority of studies are cross-sectional.

The relationship between parental feeding practices and children's eating behavior

Parents aim to affect children's eating through their feeding practices, although the strategies applied don't always work as intended (Birch & Fisher, 1998). For example, greater pressure to eat is associated with lower food intake (Ventura & Birch, 2008; Webber, Cooke, Hill, & Wardle, 2010a), even though parents probably apply such strategy to increase children's intake (Ventura & Birch, 2008). At first sight parental pressure to eat might therefore seem counterproductive. However, parents may try to increase child eating for various reasons, such as the view that the child is too thin or needs to eat more. Therefore, the above-mentioned associations between parental feeding practices and children's eating behavior may reflect child effects, such as those of weight, rather than parental effects. In accordance with such assumption, research shows that parental feeding practices are related to child weight (Jansen et al., 2012): parents who perceive their children as overweight rely less on pressure to promote eating (Brann & Skinner, 2005) and more on restriction compared to parents of slimmer children (Francis, Hofer, & Birch, 2001).

Weight is also related to eating behavior: overweight children are more food-responsive and have lower satiety responsiveness compared to normal weight children; low satiety responsiveness might be one of the mechanisms through which genetic predisposition leads to weight gain (Llewellyn, Trzaskowski, van Jaarsveld, Plomin, & Wardle, 2014). Thus, over time, weight is not only affected by obesogenic eating behavior, but will also affect such eating due to a reciprocal reinforcing mechanism. Notably though, the cited evidence suggesting this effect is cross-sectional, involving comparisons of children with different weight status. The current study therefore extends such research by adjusting for the effect of children's BMI on their own eating behavior and their parents' feeding practices.

Further, given that children's eating behavior mediates the relation between feeding and weight (Ventura & Birch, 2008), it is likely that parents' feeding practices are affected by children's eating behavior, not only by the child's weight. Consistent with this claim, Webber and associates (2010a) found that parental pressure to eat was positively associated with satiety responsiveness and eating rate (i.e., slowness in eating), and negatively associated with enjoyment of food in 7- to 9-year-old children in their cross-sectional study. However, do children become less self-regulated eaters because parents pressure them to eat more than their internal signals of fullness dictate, or is the pressure to eat an attempt to handle what appears to be food-avoidance in children?

Restriction or controlling feeding practices are positively associated with food responsiveness (Jansen et al., 2012; Webber et al., 2010a) and eating in the absence of hunger, thereby reflecting less ability to self-regulate energy intake (Birch, Fisher, & Davison, 2003; Johnson & Birch, 1994). Again, the evidence just cited cannot distinguish whether parent's control over eating is a *cause* or a *consequence* of the child's impaired self-regulation. Prospective studies examining bi-directional relations, such as that presented herein, are needed to illuminate direction of influence. To our knowledge, only a single study has examined how children's eating behavior prospectively relate to parental feeding practices, with evidence providing some support for the eating behavior → feeding practices pathway: Rodgers et al (2013) observed that toddlers' tendency to overeat predicted increases in instrumental feeding and emotional eating predicted parental control, whereas food approaching behavior was negatively related to future instrumental feeding. Even if the temporal ordering of predictors and outcomes in this work represented a methodological strength relative to prior cross-sectional work, similar to this latter research (e. g., Webber et al., 2010a), Rodgers et al (2013) considered only one predictor at a time, without taking into account the interdependence of the predictors. Given that different aspects of eating behavior

are associated with one another (Ashcroft et al., 2008), as are different feeding practices (Rodgers et al., 2013; Sleddens, Kremers, De Vries, & Thijs, 2010), multivariate analyses would seem a more appropriate way to address the issue at hand. At present there is insufficient evidence to suggest that *specific* parental feeding practices predict *specific* child eating behaviors or *vice versa*. We therefore examined a model with paths between all feeding practices and all eating behaviors.

Having highlighted limitations of available evidence and thus the need for (1) repeated measurements of parental feeding and child eating behavior to afford the temporal ordering of predictors and outcomes while potentially illuminating reciprocal processes of influence, (2) the simultaneous consideration of multiple features of feeding and eating behaviors and (3) controls for “third-variable” confounding measurements, three main hypotheses are tested in this study of a representative sample of six-year-old Norwegian children, followed up at age 8: (1) With regard to the feeding-eating relation, given that instrumental feeding, encouragement to eat and control over eating are positively associated with weight (Faith, Berkowitz, et al., 2004; Musher-Eizenman et al., 2009; Rodgers et al., 2013; Ventura & Birch, 2008), we predict that increased reliance on these feeding practices will predict greater food-approaching behavior in children (i.e., increased food responsiveness, enjoyment of food and emotional overeating) and lower satiety responsiveness, as well as a higher eating rate (slowness in eating). (2) With regard to the eating-feeding relation, because weight-status is positively associated with the use of restriction (Francis et al., 2001) and negatively associated with encouragement to eat (Brann & Skinner, 2005), and the association between weight and feeding goes through eating behavior (i.e., parents restrict foods due to weight, and weight is positively linked to food approaching behavior), we expect greater food-approaching eating behavior to predict greater parental control over eating and less parental encouragement to

eat. (3) Finally and based on the findings of Rodgers et al (2013), we expect greater food-approaching eating behavior to predict less instrumental feeding.

Method

Participants and design

Two cohorts of children born in 2003 and 2004 and their parents living in Trondheim, Norway were invited by letter to participate in a longitudinal study and complete a brief measure of emotional behavioral problems, the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997; Sveen, Berg-Nielsen, Lydersen, & Wichstrom, 2013) version 4-16 (N= 3,456). At the routine community health checkup for Norwegian 4-year olds, the health nurse described the study and obtained the parents' written consent to participate (5.2% of eligible parents were missed) (n = 2,475). To increase the variability, and thus, the statistical power, we oversampled for emotional and behavioral problems using the SDQ. The statistical analyses accounted for this oversampling to produce appropriate population estimates (see Results). Families were followed up two and four years later. Additional recruitment and procedure details are described in Wichstrøm et al. (2012). Because feeding and eating data were first obtained at age 6 and again at age 8, we focused on these time points. At age 6, 797 children participated (mean age = 6.7 years, SD = .17), whereas 689 children (mean age = 8.8 years, SD = .24) participated at follow-up two years later. See Table 1 for sample characteristics. All procedures were approved by the Regional Committee for Medical and Health Research Ethics.

Measures

Child eating behavior was measured using the Norwegian version of Wardle et al.'s (2001) Children's Eating Behaviour Questionnaire (CEBQ). We included the following subscales, the items of which were rated on a 5-point Likert scale (from *Never* to *Always*): Food responsiveness (5 items, $\alpha = .65$, e.g., "Given the choice, my child would eat most of the

time”), enjoyment of food (4 items, $\alpha = .81$, e.g., “My child enjoys eating”), emotional overeating (4 items, $\alpha = .75$, e.g., “My child eats more when worried”), satiety responsiveness (5 items, $\alpha = .70$, e.g., “My child gets full easily”) and slowness in eating (4 items, $\alpha = .71$, e.g., “My child takes more than 30 minutes to finish a meal”). Behavioral data has served to validate this instrument (Carnell & Wardle, 2007b), which displays good test-retest reliability (Wardle et al., 2001).

Parental feeding practices were assessed using parent reports. Children’s involvement in other aspects of the larger project from which this report is based on precluded devoting time to implementing a child report of parental feeding. The Parent Feeding Style Questionnaire (PFSQ) (Wardle et al., 2002), which has good test-retest reliability (Wardle et al., 2002), was used to assess three aspects of feeding, each of which has documented association with weight and obesogenic eating (Faith, Scanlon, et al., 2004): Instrumental feeding (4 items, $\alpha = .67$, e.g., “I reward my child with something to eat when s/he is well-behaved”); encouragement to eat (8 items, $\alpha = .69$, e.g., “I praise my child if s/he eats what I give her”); and control over eating (10 items, $\alpha = .66$, e.g. “I decide how many snacks my child should have”). Responses were rated on a 5-point Likert scale (from *Never* to *Always*).

Covariates. Three covariates were measured. *Child and parent BMI* were calculated based on digital-scale determined weight (Tanita BC420MA) measured to the closest .1 kg and height (Heightronic digital stadiometer; QuickMedical, Model 235A) measured to the closest .01 cm. Correction for light indoor clothing (0.5 kg for children and 1.0 kg for adults) was applied. Family *SES* was based on the 6-level classification of the parents’ occupation (1 = leader to 6 = unskilled worker) according to the International Classification of Occupations (International Labour Office, 1990),

Results

Correlation analyses assessed the bivariate associations between the parental feeding measures and the child eating variables. An autoregressive cross-lagged analysis within a structural equation modeling (SEM) framework was used to test prospective and bidirectional relations between parents' feeding practices and children's eating behaviors. Hence, a multivariate model that included all feeding practices and eating behaviors at both ages was tested, adjusting for the covariates. In this multivariate model, children's eating behaviors and parents' feeding practices, as well as covariates, at age 6 were all allowed to correlate. In a similar fashion, at age 8, the residuals of eating behaviors and feeding practices were allowed to correlate. As a consequence the model was fully specified and therefore fit the data completely. Hence, all fit indices were perfect.

The model tested the paths from child eating behaviors at age 6 to parental feeding at age 8 and from parental feeding at age 6 to children's eating behaviors at age 8. Because we used a screen-stratified sample, all analyses were performed using probability weights, which were the inverse of the drawing probability (i.e., low scorers on the SDQ were weighted up and high scorers were weighted down) to produce accurate population estimates. A robust maximum likelihood estimator was applied, which is robust to moderate deviations from multivariate normality and provide robust standard errors. Missing data were handled with a full information maximum likelihood procedure. This procedure implies that analyses are performed on all available data, provided that cases have values for the dependent variable. The analysis sample size was therefore $n = 623$. Analyses were performed using Mplus 7.0 software (Muthèn & Muthèn, 1998-2010).

Preliminary Analysis: Descriptive Statistics and Correlations

As shown in Table 2, most parents reported relatively high levels of encouragement to eat and control over eating (given that the maximum on these scales was 5), especially compared to instrumental feeding at both ages. Regarding the children's eating behavior, a

relatively high level of enjoyment of food was reported, particularly in comparison with emotional overeating and food responsiveness, again at both times of measurement.

Table 3 displays the correlations between the parental feeding and child eating measures at ages 6 and 8. As expected, multiple measures within each domain were not completely independent. Strong continuities in parental feeding practices and child eating behaviors from age 6 to 8 were observed. Moreover, parental feeding practices measured at age 6 were also prospectively associated with other feeding practices at age 8 (e.g., encouragement to eat at age 6 and control over eating at age 8). Significant relations also emerged between the different eating behavior subscales, although these associations ranged from small and insignificant (e.g., food responsiveness and slowness in eating at age 6) to substantial (e.g., food responsiveness and emotional overeating at age 6). Further, some of the feeding and eating measures were moderately related to each other over time (e.g., instrumental feeding at age 6 and emotional overeating at age 8). Overall, these cross-lagged correlations underscore the importance of applying multivariate analyses that account for these relationships.

Primary Analysis: Structural Equation Modeling Results

Table 4 displays the reciprocal relations between parental feeding practices and children's eating behavior, with significant paths presented in Figure 1. In this SEM, the initial levels of all variables were adjusted for, in addition to the adjustment for child BMI, parental BMI and SES at age 6. Inspection of Table 4 reveals that, even though the effects were small, parental feeding predicted future child eating behavior, over and beyond the effect of initial child eating behavior. Specifically, greater instrumental feeding at age 6 predicted increased food responsiveness and emotional overeating at age 8. Further, greater parental encouragement to eat predicted increased levels of enjoyment of food. Just as notably, but surprisingly, child eating behavior did not (significantly) predict future parental feeding

behavior. Although the data indicated that child BMI did not predict future parental feeding behavior, child BMI did forecast child eating behavior. Specifically, the higher a child's BMI at age 6, the greater the child's food responsiveness and lower satiety responsiveness two years later.

Discussion

This study is the first to prospectively examine the reciprocal relationships between a range of parental feeding and child eating behaviors in school-aged children after adjusting for the relationships between the variables and accounting for factors that have been shown to affect the outcomes (i.e., child BMI, parental BMI and family SES). Although children's eating behavior is stable and is established at an early age (Ashcroft et al., 2008), results from this non-experimental, observational study suggest that parental practices may be a way in which obesogenic eating behavior can be prevented or reduced. Intervention studies are most certainly needed to test such an inference.

Parental feeding practices prospectively predict children's eating behavior

The mean scores of parental feeding practices and children's eating behavior were similar to those reported in previous studies (Ashcroft et al., 2008; Mallan et al., 2014; Sleddens et al., 2014; Svensson et al., 2011; Wardle et al., 2002). The prediction of feeding practices on children's eating behavior indicated that more parental encouragement to eat at age 6 predicted comparatively more enjoyment of food among children two years later. The effects were relatively small, which is not surprising given that we accounted for initial levels of eating behaviors, which were fairly stable. Nevertheless, our finding confirms the results of previous cross-sectional studies (Faith, Scanlon, et al., 2004) and agrees with the previously reported prospective association between parental encouragement to eat and preschoolers' tendency to overeat (Rodgers et al., 2013). Encouragement to eat might positively reinforce children's eating and contribute to tendencies to eat in response to external prompts rather

than internal satiety signals (Rodgers et al., 2013). Alternatively—or additionally—the current findings might indicate that encouragement to eat makes self-regulated eaters more food-approaching from 6 to 8 years of age, which would probably accord with the parent's intentions to encourage their children to eat. As noted though, the detected effects were small and the practical significance of the findings thus remains unclear. The small effects observed here indicate a prospective relationship, but they do not necessarily speak to the expected effects in interventions, because interventions may alter parental feeding practices beyond what is typically seen in observational studies like the present one. A recently published randomized controlled trial targeting mothers' feeding practices towards their infants did report a consistent and sustained intervention effect over time (Daniels et al., 2015). Future studies are needed to examine whether such effects are seen in the preschool and school age years.

In contrast to the current findings, parental encouragement to eat did not uniquely predict food-approaching behavior in a study of toddlers (Rodgers et al., 2013). This discrepancy in findings might suggest that the effect of parental encouragement to eat on children's eating behavior, at least as inferred from observational data, are more pronounced in the early school years as opposed to in toddlerhood, possibly because children's eating is increasingly shaped by external factors as they grow (Johnson & Taylor-Holloway, 2006). It is also possible that the Rodgers et al. study (2013) did not have enough power ($n = 222$) to detect a rather small effect. As hypothesized, more instrumental feeding (parental use of food as a reward) predicted increased food-approaching behavior, that is, enjoyment of food and emotional overeating. Previous research indicates that instrumental feeding is associated with higher BMI (Musher-Eizenman et al., 2009; Rodgers et al., 2013) and greater food intake in children (Cooke, Chambers, Anez, & Wardle, 2011). The current study adds to these findings by revealing a prospective relationship between greater parental use of food as a reward and

more obesogenic eating behavior, suggesting that food-approaching behavior mediates the relation between instrumental feeding and food intake. Such findings suggest (though given the observational nature of the evidence, cannot confirm) that instrumental feeding promotes food-approaching behavior, independent of the child's weight status. It seems reasonable to hypothesize that parental use of food as a reward increases the child's interest in and drive for food and that such an effect on motivation can account for the associations between instrumental feeding and food-approaching behavior. Moreover, some evidence indicates that children develop preferences for those foods used as rewards by parents (Birch, 1999; Birch, Zimmerman, & Hind, 1980), although the results are inconsistent across studies (Cooke et al., 2011; Lanfer et al., 2013).

Because food-approaching behavior is associated with increased food intake and weight in children (Carnell & Wardle, 2008a; Webber et al., 2009), the data indicating that parental encouragement to eat and instrumental feeding predict increases in such eating behavior might suggest that these feeding practices indirectly cause increased weight gain in children. However, in a study of 7- to 9-year-olds that were followed up 3 years later, Webber et al (2010b) did not find parenting practices to predict BMI. Notably though, evidence for the reverse prediction was found; higher child BMI predicted increased parental monitoring of eating and lower use of pressure to eat from baseline to follow-up. Thus, the relationship between parental feeding, children's eating and weight is still unclear.

Children's eating behavior does not prospectively predict parental feeding practices

To the best of our knowledge, only one other study has examined the prospective relation between children's eating behaviors and parental feeding practices, revealing some evidence of child effects in preschoolers (Rodgers et al., 2013). We failed to replicate this finding, as none of the eating behaviors examined herein predicted parental feeding practices two years later. These contrasting results might be due to several factors, including a longer

follow-up, statistical adjustment for multiple eating and feeding behaviors and child BMI, and the focus on school-aged rather than toddlers in the current research, all of which contrast with the methods used by Rodgers et al. (2013). Overall, our results indicate that although school-aged children's weight may predict – and possibly influence – parental feeding practices, children's eating behavior itself does not appear to predict such practices. Thus, it seems likely that it is the child's weight that concerns the parents rather than their eating behavior per se.

Limitations

Although our research has several strengths, such as a large and population-representative sample, a prospective design, and multivariate analyses, it must be acknowledged that parental evaluations of feeding practices and eating behavior could be affected by social desirability. Although there are many advantages to employing observations and laboratory tests relative to questionnaires, these advantages are mitigated by high costs in population studies such as the present (Carnell & Wardle, 2008b), which is why we relied on parental reports. Notably, the eating behavior measure used in this study correlates tolerably well with laboratory-based tests of eating behavior (Carnell & Wardle, 2007b). The fairly low internal consistency of the parent feeding questionnaire should be noted as a limitation, possibly deflating the observed associations. Further, because the parents provided information on both their own feeding practices and child eating, a respondent bias may have inflated discerned associations. Such potential bias might, to some extent, be mitigated by the fact that the prediction in both domains controlled for prior measurements, hence adjusting for concurrent bias. Although such adjustment might reduce the influence of respondent effects, biases introduced by a single informant cannot be completely discounted. Therefore, including a self-reported measure of eating behavior would have been an advantage. Nevertheless, we believe that the reliance on a large sample and a

multivariate longitudinal design, despite the measurement of only two time points, advances our understanding of the possible cause-effect relationships between parental feeding practices and children's eating behavior. As noted above, an experimental intervention study is required to confirm whether our observational findings reflect causal processes.

Table 1

Sample characteristics at age 6

| Characteristics | % |
|------------------------------------------------|------|
| Gender of child | |
| Male | 49.8 |
| Female | 50.2 |
| Gender of parent informant | |
| Male | 18.9 |
| Female | 81.1 |
| Ethnic origin of biological mother | |
| Norwegian | 93.0 |
| Western countries | 6.8 |
| Other countries | 0.3 |
| Ethnic origin of biological father | |
| Norwegian | 93.0 |
| Western countries | 6.5 |
| Other countries | 0.5 |
| Informant parent's socioeconomic status | |
| Leader | 12.5 |
| Professional, higher level | 36.7 |
| Professional, lower level | 36.2 |
| Formally skilled worker | 14.1 |
| Farmer/fishermen | 0.0 |
| Unskilled worker | 0.6 |

Table 2

Mean scores of parental feeding practices and children's eating behavior at ages 6 and 8 (N=623)

| | Age 6 | Age 8 |
|------------------------|-------------------|-------------------|
| | Mean (95%CI) | Mean (95%CI) |
| Feeding practice | | |
| Instrumental feeding | 1.64 [1.60, 1.69] | 1.47 [1.43, 1.51] |
| Encouragement to eat | 3.83 [3.79, 3.87] | 3.77 [3.72, 3.82] |
| Control over eating | 4.06 [4.03, 4.09] | 3.98 [3.95, 4.02] |
| Eating behavior | | |
| Food responsiveness | 1.88 [1.84, 1.92] | 1.86 [1.81, 1.91] |
| Enjoyment of food | 3.43 [3.38, 3.48] | 3.47 [3.41, 3.52] |
| Satiety responsiveness | 2.94 [2.89, 2.98] | 2.83 [2.78, 2.88] |
| Slowness in eating | 2.54 [2.49, 2.60] | 2.39 [2.35, 2.46] |
| Emotional overeating | 1.42 [1.38, 1.45] | 1.41 [1.37, 1.46] |

Running head: PARENTAL FEEDING AND CHILD EATING

Table 3
Bivariate correlations between parents' feeding practices children's eating behavior

| Age 6 | | | | | | | | Age 8 | | | | | | | | |
|---------|------|------|---------|--------|--------|---------|--------|---------|--------|--------|---------|--------|---------|---------|--------|---------|
| | IF | EN | CE | FR | EF | SR | SE | EOE | IF | EN | CE | FR | EF | SR | SE | EOE |
| Age 6 | | | | | | | | | | | | | | | | |
| Feeding | | | | | | | | | | | | | | | | |
| IF | 1.00 | .11* | -.19*** | .35*** | -.02 | .10* | .05 | .39*** | .54*** | .03 | -.09 | .31*** | .03 | .06 | .04 | .37*** |
| EN | | 1.00 | .28*** | .01 | .24*** | -.02 | .03 | -.01 | .03 | .59*** | .26*** | .05 | .27*** | .02 | .08 | -.03 |
| CE | | | 1.00 | -.12** | .13** | -.08 | .06 | -.20*** | -.10* | .24*** | .57*** | -.05 | .12* | -.01 | .02 | -.16** |
| Eating | | | | | | | | | | | | | | | | |
| FR | | | | 1.00 | .28*** | -.18*** | .03 | .59*** | .22*** | -.04 | -.08 | .65*** | .21*** | -.17** | .11* | .45*** |
| EF | | | | | 1.00 | -.50*** | -.10 | .10* | .00 | .12* | .08 | .20*** | .70*** | -.42*** | -.03 | .03 |
| SR | | | | | | 1.00 | .20*** | -.02 | .07 | -.01 | -.11 | -.04** | -.38*** | .64*** | .18*** | .05 |
| SE | | | | | | | 1.00 | .02 | -.00 | .08 | .03 | .02 | -.12* | .18** | .65*** | .04 |
| EOE | | | | | | | | 1.00 | .20*** | -.08 | -.18** | .40*** | .03 | -.00 | .04 | .59*** |
| Age 8 | | | | | | | | | | | | | | | | |
| Feeding | | | | | | | | | | | | | | | | |
| IF | | | | | | | | | 1.00 | .07 | -.17*** | .26*** | .04 | .10* | .02 | .37*** |
| EN | | | | | | | | | | 1.00 | .28*** | .03 | .25*** | .03 | .11* | -.06 |
| CE | | | | | | | | | | | 1.00 | -.00 | .15** | -.11 | .05 | -.18*** |
| Eating | | | | | | | | | | | | | | | | |
| FR | | | | | | | | | | | | 1.00 | .27*** | -.23*** | .09* | .52*** |
| EF | | | | | | | | | | | | | 1.00 | -.51*** | -.06 | .04 |
| SR | | | | | | | | | | | | | | 1.00 | .19*** | .04 |
| SE | | | | | | | | | | | | | | | 1.00 | .05 |
| EOE | | | | | | | | | | | | | | | | 1.00 |

Note. *= $p < .05$; **= $p \leq .01$; ***= $p \leq .001$. IF=instrumental feeding; EN=encouragement to eat; CE=control over eating; FR=food responsiveness; EF=enjoyment of food; SR = satiety responsiveness; SE=slowness in eating; and EOE=emotional overeating.

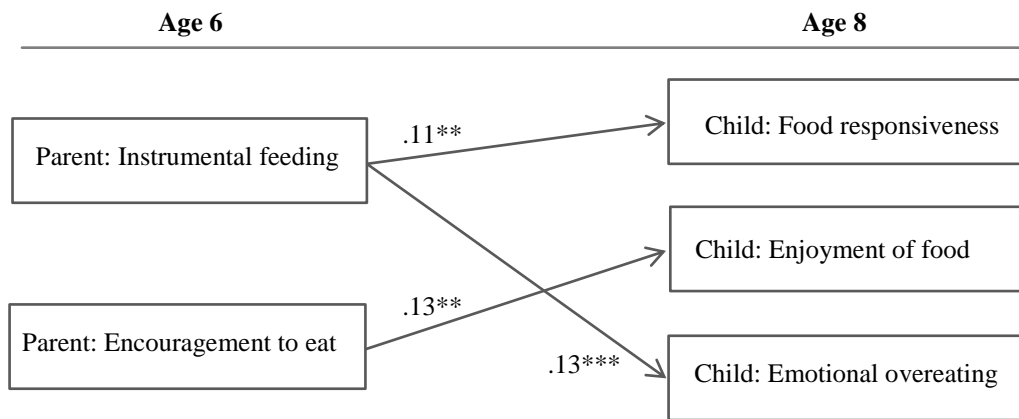
Running head: PARENTAL FEEDING AND CHILD EATING

Table 4
The prospective reciprocal relationship between parents' feeding practices and children's eating behavior (N=623)

| Feeding practice | | | | | | | Eating behavior | | | | | | | | | |
|---------------------|----------------------|------|----------------------|------|----------------------|------|----------------------|------|----------------------|------|-------------------------|------|----------------------|------|----------------------|------|
| Age 8 | Instrumental Feeding | | Encouragement to eat | | Control over Eating | | Food Responsiveness | | Enjoyment of food | | Satiety Responsiveness | | Slowness in eating | | Emotional overeating | |
| Age 6 | B (95% CI) | β | B (95% CI) | β | B (95% CI) | β | B (95% CI) | β | B (95% CI) | β | B (95% CI) | β | B (95% CI) | β | B (95% CI) | β |
| Feeding | | | | | | | | | | | | | | | | |
| IF | .49*** (.40, .58) | .52 | .02 (-.06, .10) | .02 | .02 (-.04, .09) | .03 | .11* (.02, .20) | .11 | .06 (-.03, .14) | .05 | -.01 (-.09, .08) | -.01 | -.04 (-.14, .07) | -.03 | .13*** (.06, .20) | .13 |
| EN | -.00 (-.09, .08) | -.01 | .64*** (.55, .73) | .58 | .07 (-.01, .14) | .08 | .03 (-.06, .12) | .02 | .13** (.04, .22) | .10 | .06 (-.03, .16) | .05 | .04 (-.07, .16) | .03 | -.00 (-.07, .07) | -.00 |
| CE | -.01 (-.09, .11) | .01 | .06 (-.06, .19) | .05 | .55*** (.47, .64) | .53 | .04 (-.05, .13) | .03 | .05 (-.06, .16) | .03 | .05 (-.07, .16) | .03 | .04 (-.10, .18) | .02 | -.04 (-.14, .07) | -.03 |
| Eating | | | | | | | | | | | | | | | | |
| FR | .07 (-.03, .17) | .07 | -.01 (-.12, .10) | -.01 | .02 (-.06, .09) | .02 | .62*** (.50, .74) | .57 | -.01 (-.13, .11) | -.01 | .01 (-.10, .12) | .01 | .18** (.05, .31) | .14 | .16*** (.07, .25) | .16 |
| EF | .02 (-.06, .11) | .03 | -.02 (-.10, .08) | -.02 | -.02 (-.09, .05) | -.03 | -.01 (-.09, .08) | -.01 | .65*** (.56, .73) | .64 | -.15** (-.24, -.05) | -.15 | .04 (-.07, .14) | .03 | -.01 (-.08, .06) | -.01 |
| SR | .05 (-.04, .13) | .05 | -.03 (-.13, .06) | -.04 | -.07 (-.16, .01) | -.10 | -.01 (-.09, .07) | -.01 | -.08 (-.17, .01) | -.07 | .54*** (.45, .64) | .51 | .15** (.04, .26) | .12 | .06 (-.02, .14) | .07 |
| SE | -.03 (-.08, .01) | -.05 | .04 (-.03, .10) | .05 | -.00 (-.05, .04) | -.00 | -.01 (-.06, .05) | -.01 | -.06 (-.13, .01) | -.07 | .05 (-.02, .11) | .06 | .62*** (.53, .70) | .63 | -.01 (-.07, .05) | -.02 |
| EOE | -.02 (-.13, .09) | -.02 | -.05 (-.15, .06) | -.04 | -.08 (-.16, .00) | -.09 | .03 (-.07, .13) | .03 | -.01 (-.12, .09) | -.01 | .03 (-.07, .16) | .03 | -.08 (-.20, .03) | -.06 | .46*** (.36, .56) | .45 |
| Covariates | | | | | | | | | | | | | | | | |
| Child BMI | -.02 (-.05, .01) | -.08 | -.02 (-.05, .02) | -.05 | -.00 (-.03, .02) | -.02 | .04* (.01, .07) | .12 | .00 (-.03, .03) | .00 | -.05*** (-.08, -.03) | -.16 | .00 (-.04, .04) | -.00 | .01 (-.01, .03) | .03 |
| Parental BMI | .01 (-.01, .01) | .05 | -.00 (-.01, .01) | -.01 | .00 (-.01, .01) | -.00 | -.00 (-.01, .01) | -.01 | -.00 (-.01, .00) | -.04 | .01 (-.00, .01) | .05 | .01 (-.00, .01) | .05 | -.00 (-.01, .00) | -.06 |
| Parental SES | .03 (-.01, .07) | .06 | .00 (-.05, .05) | .00 | -.02 (-.05, .02) | -.04 | .01 (-.02, .05) | .02 | -.02 (-.07, .03) | -.04 | -.00 (-.04, .04) | -.00 | -.01 (-.06, .04) | -.02 | .02 (-.01, .06) | .05 |

Note. *= $p < .05$; **= $p \leq .01$; ***= $p \leq .001$. IF=instrumental feeding; EN=encouragement to eat; CE=control over eating; FR=food responsiveness; EF=enjoyment of food; SR=satiety responsiveness; SE=slowness in eating; EOE=emotional overeating; BMI=Body Mass Index.

Figure 1. Significant prospective paths (β) of the multivariate model (see Table 4) exploring the reciprocal relations between parental feeding practices and children's eating behavior, adjusted for children's BMI, parental BMI, parental SES and initial levels of all variables (not displayed). Asterisks indicate the level of significance (*= $p < .05$; **= $p \leq .01$; ***= $p \leq .001$).



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