Mealtime structure and responsive feeding practices are associated with less food fussiness and more enjoyment of food in children aged 1-10 years

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Conflict of interest: The authors indicate that they have no personal financial relationships relevant to this article to disclose.

Acknowledgments: We acknowledge Dr. Lucinda Bell and Associate Professor Anthea Magarey for their contribution to the study design. We sincerely thank all of the participants for completing the questionnaire.

ABSTRACT

Objective: The aim of this study was to identify associations between structure-related and non-responsive feeding practices and children's eating behaviors.

Design: Cross sectional online survey design.

Participants: Parents (n=413) of 1-10 year old children.

Main Outcome Measures: Parental feeding practices and child eating behaviors were measured via the validated Feeding Practices and Structure Questionnaire and the Children's Eating Behaviour Questionnaire.

Analysis: Associations between parental feeding practices and children's eating behaviors were tested using hierarchical multivariable linear regression models, adjusted for covariates.

Results: Feeding practices accounted for 28% and 21% of the variance in Food Fussiness and Enjoyment of Food, respectively. For all other eating behaviors the amount of variance explained by feeding practices was <10%. Key findings were that more structure and less non-responsive practices were associated with lower Food Fussiness and higher Enjoyment of Food.

Conclusions and Implications: Overall the findings suggest that mealtime structure and responsive feeding are associated with more desirable eating behaviors. Contrary to predictions there was no evidence to indicate that these practices are associated with better self-regulation of energy intake. Longitudinal research and intervention studies are needed to confirm the importance of these feeding practices for children's eating behaviors and weight outcomes. (198 words)

Keywords: Feeding practices; Child eating behavior; Responsive feeding; Mealtime structure.

INTRODUCTION

Parents play a key role in the development of their child's dietary preferences and eating behaviors. Parents determine which foods are available, and how children are fed.[1] Eating behaviors established in childhood can persist into adolescence and adulthood, with implications such as continued fussiness and poor dietary variety[2, 3] or high responsiveness to food cues and increased obesity risk.[4] While eating behaviors and child weight are difficult to modify directly, parental feeding practices are potentially a good target for interventions to prevent unhealthy eating patterns and overweight in children.[5]

Parental feeding practices refer to the behavioral strategies a parent uses to control how much, what, when and where their child eats.[1] Early parental feeding practices have the potential to support or undermine children's ability to self-regulate their energy intake.[4] The Trust Model proposes that providing a structured mealtime environment and using responsive feeding practices will have a protective effect on maintaining this self-regulation ability.[6] Responsive feeding involves identifying and appropriately responding to the child's satiety and hunger cues.[4]

While a range of feeding practices have been examined, most researchers have focused on controlling feeding practices such as restriction or pressuring the child to eat.[7] These feeding practices are considered to be non-responsive, in that they may override a child's ability to eat according to their internal hunger and satiety cues, which may induce a child to overeat and can potentially lead to childhood overweight.[8] Using food to reward the child for eating a particular food or in response to behavior is also considered a non-responsive feeding practice and can result in increased preference for the reward food and decreased preference for the food that was

initially promoted.[9, 10] While parents may use these feeding practices with the intention of promoting a healthy and balanced intake, cross-sectional evidence indicates that children whose parents use non-responsive feeding practices are more likely to be fussy eaters, display emotional eating behaviors and respond to external food cues.[11-16] This cross-sectional evidence does not imply causality and the relationship between parent feeding practices and children's eating behaviors is likely to be bidirectional.[17]

There has been little research on the role of the structured mealtime environment, despite suggestions that providing a structured feeding environment is a key component in promoting development of healthy eating patterns in children.[6, 8] A structured mealtime environment includes providing a routine in terms of location, timing, reduced distractions and family presence at the table. Providing this structure is proposed to help children attend and respond to their hunger and satiety cues, which may help maintain their self-regulatory capability. Studies that have assessed the structured mealtime environment have used a range of tools and a range of outcome measures, including eating behaviors, dietary intake and child weight. The initial validation study of the Feeding Practice and Structure Questionnaire (FPSQ) in a sample of 462 mothers of 2 year old children found associations that confirmed the theorized positive relationship between structure-related feeding practices and children's eating behaviors, with Structured Meal Setting and Family Meal Setting positively associated with Enjoyment of Food and negatively associated with emotional eating and Fussiness.[14]

As parental feeding practices are potentially modifiable, identifying practices that are associated with healthy eating behaviors will allow development of child feeding interventions to improve dietary intake patterns and reduce obesity risk. If provision of structure proves to be associated with healthy eating behaviors then this can provide a very practical focus for interventions. The

aim of this study was therefore to identify associations between structure-related and non-responsive feeding practices and children's eating behaviors in a sample of 1-10 year olds.

METHODS

Participants

Participants were mostly (99%) biological parents of children aged 1-10 years (n=413), recruited through social media websites including Facebook, parenting forums and university staff and student email distribution lists. Eligible parents were >18 years old, had computer access to the internet and ability to fill in an English questionnaire. Participants were not eligible if their child had a diagnosed congenital abnormality or chronic condition likely to influence normal development. In total 628 participants commenced the online survey, 12 of whom were the parents of the same child (6 couples). Two participants did not have a child within the specified age range and a further 213 were excluded due to missing data on the key variables included in the present study. Meaningful comparison between those included and excluded was not possible given that many of those excluded provided very little data (for instance, 73 participants did not proceed past the first question of the survey). Approval was obtained from the Queensland University of Technology Human Research Ethics Committee (Approval Number 1400000033).

Measures

Parental feeding practices.

Non-responsive and structure-related parental feeding practices were measured using the revised

FPSQ: the FPSQ-28.[18] The FPSQ-28 contains 28 items loading onto 7 factors and an additional single item indicator of Family Meal Setting (*My child eats the same food as the rest of the family*). In line with the focus of the current study the 3 non-responsive feeding factors (Reward for Behavior (eg., *I offer my child his/her favorite foods in exchange for good behavior*, previous study α_p=.80, current study α_c=.80), Reward for Eating (eg., *I use desserts as a bribe to get my child to eat his/her main course*, α_p=.84, α_c=.91) and Persuasive Feeding (eg., *If my child says "I'm not hungry" I try to get him/her to eat anyway*, α_p=.75, α_c=.79), the 2 structure-related factors (Structured Meal Setting (eg., *I insist my child eats meals at the table*, α_p= .68, α_c=.75), Structured Meal Timing (eg., *I decide when it is time for my child to have a snack*, α_p=.57, α_c=.62), and the single item indicator (Family Meal setting) were selected. The Overt Restriction and Covert Restriction factors were not included in the analysis. Item response options were a 5-point Likert scale (1-5) from "never" to "always" or "disagree" to "agree". Mean scores for each factor were calculated. The FPSQ-28 has been validated for use in Australian first-time mothers of children at ages 2, 3.7 and 5 years[18] and in the present sample of 1-10 year olds (manuscript in preparation). Internal reliability estimates for FPSQ factors were within the acceptable range in this sample (i.e. >.70)[19] with the exception of Structured Meal Timing (α=.62). This factor has been retained, however the lower reliability of this factor should be considered when interpreting the results.

Children's eating behaviors.

The Children's Eating Behaviour Questionnaire (CEBQ)[20] is a validated and widely used 35-item tool to assess 8 eating behavior factors. The CEBQ has been validated in a range of populations, including a multi-ethnic Australian sample of mothers with children from 1 year of age.[21] In the current sample internal consistency for each factor is as follows: Satiety Responsiveness (α=.76), Slowness in Eating (α=.83), Food Fussiness (α=.92), Emotional Undereating (α=.76)**,** Food

Responsiveness (α=.77), Enjoyment of Food (α=.88), Desire to Drink (α=.87), and Emotional Overeating (α=.77). Items were measured on a 5-point Likert scale (1-5) from "never" to "always". Mean scores for each factor were calculated.

Covariates

Parents reported own and child gender, own and child age (years and months), education level (dichotomized into university degree or no university degree), marital status (married/living with partner vs single/not living with partner) and relationship with the child. Parent BMI was calculated for participants who provided self-reported height and weight data (n=333 excluding pregnant mothers). Parents reported their child's height and weight and BMI-for-age Z scores were calculated using WHO Anthro[22]. Extreme Z scores > +5 or -5 were noted (n=3) and removed prior to analysis.

Data Management and Statistical Analysis

Statistical analyses were conducted using SPSS Version 21.0.0 (SPSS Inc., Armonk, NY, 2012). Significance was set at $p<.05$. The distributions of FPSQ-28 and CEBQ factors were assessed visually using histograms. Family Meal Setting and Structured Meal Setting were negatively skewed. Distribution was not improved by square root, log or reciprocal transformations; therefore the Family Meal Setting and Structured Meal Setting factors were dichotomized to a median split and entered into analysis. This did not change the pattern of associations; therefore all factors were used as continuous mean scores.

Hierarchical linear multiple regressions were used to test the association between parental feeding practices and children's eating behaviors, while adjusting for covariates. A separate regression model was run for each of the 8 eating behaviors. Parent age, level of education, child

gender and child age were entered in step 1. The 3 non-responsive and 3 structure-related feeding practices were entered together in step 2. Due to large amounts of missing data for parent BMI and child BMI Z scores (see Table 1) the regression models were also run with and without each of these variables included as a covariate in step 1 either together or separately. The pattern of associations was consistent across regression models without parent BMI and child BMI Z score (n=413), adjusted for parental BMI (n=333), adjusted for child BMI Z score (n=222) and adjusted for both parental BMI and child BMI Z score (n=185). Therefore to maximize the sample size the results of the regression models that did not include parent BMI or child BMI Z score are presented here.

RESULTS

Table 1 shows parent and child characteristics and mean scores on the FPSQ factors. Most participants were the mother (94%) of the child. Participants were based in 18 different countries, with the majority of the sample living in Australia or New Zealand. Parents reported low to moderate levels of the non-responsive practices and high levels of the structure-related practices.

Adjusted associations between parental feeding practices and children's eating behaviors are presented in Table 2. Overall the proportion of variance in the eating behaviors uniquely explained by the feeding practices (after adjusting for covariates, i.e., ΔR^2) ranged from 6-28%. Notably, the models for Food Fussiness and Enjoyment of Food explained the greatest proportion of variance. Non-responsive practices were associated with all of the eating behaviors. Persuasive Feeding and Reward for Eating were associated with higher Satiety

Responsiveness (PF: β=.18, p=.003, RE: β=.19, p=.004) and Food Fussiness (PF: β=.20, p<.001 RE: β=.30, p<.001) but lower Enjoyment of Food (PF: β=-.17, p=.003 RE: β=-.27, p<.001). Persuasive Feeding was also associated with higher Slowness in Eating (β=.26, p<.001), Desire to Drink (β=.17, p=.005) and Emotional Undereating (β=.19, p=.002). The pattern of associations between these eating behaviors was in the opposite direction for Reward for Behavior, except for a positive association with Emotional Undereating (β=.17, p=.005). Reward for Behavior was the only feeding practice to be associated with Food Responsiveness (β =.34, p<.001) or Emotional Overeating (β=.34, p<.001); in both cases higher Reward for Behavior was related to a higher level of the eating behavior. Fewer significant association were observed between the structure-related practices and eating behaviors. Structured Meal Timing (α=.62) was associated with lower Satiety Responsiveness (β=-.12, p=.023), lower Emotional Undereating (β=-.10, p=.044) and higher Enjoyment of Food (β=.12, p=.011). Family Meal Setting and Structured Meal Setting were both associated with less Food Fussiness (FMS: β=-.31, p<.001 SMS: β=-.12, p=.013) and more Enjoyment of Food (FMS: β=.24, p=<.001 SMS: β=.16, p=.002).

DISCUSSION

The aim of this study was to identify associations between structure-related and non-responsive parental feeding practices and eating behaviors of children 1-10 years of age. The results indicated that structure-related and non-responsive feeding practices significantly contribute to variance in children's eating behaviors, in particular multiple parental feeding practices were related to Food Fussiness and Enjoyment of Food and uniquely explained 28% and 21% of the

214 variance in these behaviors, respectively. Parents who used non-responsive feeding practices and
215 provided less structure reported that their child was a fussier eater. Conversely, parents who used
216 less non-responsive feeding practices and provided more structure in terms of timing, setting and
217 family engagement, reported that their child enjoyed food more and looked forward to
218 mealtimes.

219 These cross-sectional associations between structure-related feeding practices and lower Food
220 Fussiness and higher Enjoyment of Food supported the proposed benefits of providing structured
221 mealtimes to promote children's acceptance of a variety of healthy foods.[6] These findings
222 aligned with a past validation study using the original (40 item) FPSQ in a sample of mothers of
223 2 year olds, where Family Meal Setting and Structured Meal Setting were positively associated
224 with Enjoyment of Food and negatively associated with Food Fussiness.[14] van der Horst[23]
225 proposed that Enjoyment of Food and Food Fussiness are inversely related, which the present
226 data confirms ($r=-.65$, $p<.001$). van der Horst suggest that providing a structured, pleasant
227 mealtime environment will contribute to the child's enjoyment in eating.[23] While fussiness is a
228 heritable eating trait,[24, 25] environmental factors such as parental modeling and repeated exposure
229 may influence acceptance and enjoyment of foods.[26-28] When the family eats meals together,
230 parents are potentially able to model healthy eating behaviors. A prospective study of 2-4 year
231 old children (n=156) found that parental modeling predicted higher interest in food and lower
232 fussiness after 12 months.[29] Parental modeling has also been associated with higher fruit and
233 vegetable intake,[30, 31] which may represent less fussiness.

234 In contrast to these results, parents who used more non-responsive feeding practices (Persuasive
235 Feeding and Reward for Eating) were more likely to have children who were fussier eaters and
236 less likely to have children who enjoyed food and looked forward to mealtimes. Previous cross-

237 sectional research has also found a positive association between pressure feeding and fussiness[13,
238 16] with parental reports of using less pressure for children who enjoy food.[15, 32] Prospective
239 studies have also found that pressure to eat predicted higher levels of picky eating behaviors
240 between 7 and 9 years old, and a lower interest in food in a sample of 2-4 year olds.[29, 33] Using
241 food to reward children for eating may also encourage fussy eating behaviors, as it has been
242 shown to increase their desire for the reward food, while reducing their desire for the food that
243 was originally presented.[9, 10] While the Reward for Eating factor in this study indicates the use of
244 food as rewards, there is growing evidence that the use of small non-food rewards or social
245 praise can be effective strategies to promote acceptance of foods, even in fussy eaters.[34, 35] While
246 parents use pressure with the intention of increasing intake of a food, these findings indicate that
247 pressure was not successful in increasing intake, and may have a negative impact on the child's
248 liking of the food.[36]

249 The postulated benefit of mealtime structure in terms of allowing the child to attend to their
250 satiety cues[6] were not supported by the findings of this study. The 3 structure-related parental
251 feeding practices were not positively associated with eating behaviors thought to reflect
252 children's responsiveness to internal satiety cues (Satiety Responsiveness and Slowness in
253 Eating[20]). In fact, Structured Meal Timing was associated with lower Satiety Responsiveness,
254 though it is important to consider the lower reliability of this feeding practice (α=.62). However,
255 these results need to be considered in light of the associations observed between the non-
256 responsive practices and Satiety Responsiveness and Slowness in Eating. Contrary to the Trust
257 Model,[6] both Persuasive Feeding and Reward for Eating were positively associated with these
258 eating behaviors. The same patterns of associations were also reported in the original validation
259 study of the FPSQ.[14] These findings may reflect the bidirectional nature of the feeding
260 relationship,[4] specifically a child-driven effect. Parents may interpret their child leaving food on

their plate or eating slowly as a problematic eating behavior and attempt to persuade their child to eat more, rather than understanding that this may signal the child's responsiveness to their satiety cues. This is supported by a sibling design study of 3-6 year old children (n=80 sibling pairs) that found that mothers used more pressure when feeding the sibling with reported high levels of Slowness in Eating and Satiety Responsiveness.[37]

A final observation from this study was the pattern of associations between using food as a reward for behavior and the eating behaviors. Although Reward for Behavior is conceptualized as a non-responsive feeding practice and is positively correlated with the other non-responsive feeding practices in the FPSQ-28, in a number of instances the relationship between this subscale and the eating behaviors was in the opposite direction to that observed for Persuasive Feeding/Reward for Eating and the eating behaviors. For instance, Reward for Behavior was significantly negatively associated with Satiety Responsiveness but was significantly positively associated with Food Responsiveness, Enjoyment of Food and both emotional eating subscales. Thus, Reward for Behavior tended to be positively related to the food responsive behaviors and negatively related to the satiety responsive behavior. An explanation for this somewhat contradictory pattern may be that while Persuasive Feeding and Reward for Eating are used with children whose parents believe they are not eating enough, parents of children who are quite responsive to food can effectively use food as a reward for desirable behavior.

The results of this study should be considered in light of its strengths and limitations. The inclusion of 1-10 year old children in this study represents a large age span, and it is acknowledged that feeding interactions may differ substantially over this range. While age was controlled for in the analysis, the design and sample size precluded comparison of associations between different age groups. The use of the recently developed and validated FPSQ-28 allowed

the study to capture a range of structure-related feeding practices, extending the field beyond its current focus on controlling feeding practices. However, the low reliability of the Structured Meal Timing factor is considered a limitation. The multivariable approach was a strength of the study and the unique variance accounted for by the feeding practices after adjusting for key covariates could be examined. However it is uncertain whether the results can be generalized beyond the sample which consisted of mostly biological mothers, who were highly educated, with literacy levels, motivation and ability to complete the online survey and married or living with their partner. The number of father respondents was too low to allow comparison between mothers and fathers, and previous research has indicated that their use of parental feeding practices differs from that of mothers.[38, 39] The self-reported data may be prone to response bias. However, maternal reports of child feeding have been found to be reliable and accurate reflections of independent observations.[40, 41] Another limitation of the study was the large amount of missing anthropometric data for both parents and children. For those who did provide anthropometric data, the validity of the data cannot be confirmed. Previous research has indicated that parents tend to over or under report their child's weight if they have a low or high BMI, respectively.[42] However, the main regression analyses were re-run with these anthropometric variables included and the results did not indicate that inclusion of these covariates made a substantive difference to interpretation of the present results (data not reported).

Implications for Research and Practice

One of the novel aims of this study was to investigate whether the provision of structure specifically may relate to children's eating behaviors. This study found that parents who provided a structured feeding environment tended to report that their child enjoyed food more

and was less fussy compared to parents who used less structure. Conversely, parents who used more non-responsive feeding practices such as persuading the child to eat and using food as a reward for eating were more likely to have children who displayed higher levels of fussy and/or emotional eating behaviors and tended to enjoy food less. These children were also more likely to be more satiety responsive and eat more slowly. Interventions that have focused on responsive feeding, such as the NOURISH trial[44] and the INSIGHT study[45] have demonstrated increased use of responsive feeding practices[44] and improved child outcomes.[45] Interventions may benefit from the addition of guidance on how to establish structured feeding practices to promote a varied and healthy pattern of food preferences and acceptance in children.

While the cross-sectional nature of this study precludes inferences about the direction of associations, the results add further support to the likely bidirectional nature of the relationship between parental feeding practices and children's eating behaviors.[4] Parents may implement feeding practices in response to their child, such as was shown in a longitudinal study assessing feeding practices and child weight.[43] In this study by Webber and colleagues, higher child BMI at baseline was associated with increased use of monitoring and decreased use of pressure to eat over a 3 year period.[43] Longitudinal or intervention studies are needed to assess whether use of feeding practices that are both structured and responsive in nature can directly affect children's ability to self-regulate their eating. More in-depth, potentially qualitative, research is also required to better understand the pattern of associations between the different non-responsive feeding practices and children's eating behaviors. Future studies may benefit from focusing on a smaller age group, or utilizing a longitudinal design to track how feeding interactions change over time.

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Table 1. Characteristics and Parental Feeding Practices in an International Sample of Parents of 1-10 Year Olds (n=413)

Characteristic	Mean±SD or % (n)
Child	
Gender (girl)	52 (215)
Age (years)	5.1±3.0
1-2	32 (132)
3-4	20 (83)
5-6	17 (70)
7-8	17 (70)
9-10	14 (58)
BMI-for-age Z score[a] (n=222)	.10±1.32
Parent	
Gender (female) (n=392)	94 (368)
Age (years)	35.6±5.6
BMI[b] (kg/m^2) (n=333, excluding pregnant mothers)	25.7±5.5
Underweight (<18.5)	2 (7)
Normal weight (18.5-24.9)	55 (183)
Overweight (≥25.0)	23 (76)
Obese (≥30.0)	20 (67)
Education (university degree)	73 (301)
Year 10 or equivalent	1 (4)
Year 12 or equivalent	6 (24)
TAFE certification, trade qualification	8 (33)
Diploma or equivalent	13 (53)
Bachelor degree	33 (135)
Postgraduate degree	40 (164)
Biological parent of child (yes)	99 (408)
Marital status (married or living with partner) (n=406)	94 (382)
Place of residence (n=412)	
Australia and New Zealand	61 (251)
Europe and UK	25 (103)
North America	14 (57)
Other	<1 (1)
Parental Feeding Practices[c]	
Persuasive Feeding	2.67±.80
Reward for Behavior	1.80±.80
Reward for Eating	1.96±.96
Structured Meal Setting	4.10±.78
Structured Meal Timing	3.75±.72
Family Meal Setting	4.33±.82

[a] Child BMI-for-age Z scores calculated based on parent-reported height and weight using software program WHO Anthro which references gender and age based norms[33]. n.b. 3 cases excluded with Z score > +5 or -5.

[b] Parent BMI based on self-reported height and weight. BMI Classifications: World Health Organization[32].

449 [c] From the Feeding Practices and Structure Questionnaire (FPSQ-28[26]). Mean scores for each
450 subscale based on responses to items on a scale from 1 (low) to 5 (high).

Table 2. Hierarchical Multiple Linear Regression Analyses of the Associations between Parental Feeding Practices and Children's Eating Behaviors in an International Sample of Parents of 1-10 Year Olds (n=413)

	Eating Behaviors[a]															
	Satiety Responsiveness		Slowness in Eating		Food Fussiness		Emotional Undereating		Food Responsiveness		Enjoyment of Food		Desire to Drink		Emotional Overeating	
Mean±SD	2.94±.70		2.93±.85		2.56±.91		2.63±.82		2.29±.76		3.78±.75		2.49±.93		1.63±.59	
Step 1[b] (ΔR^2, p)	.05	<.001	.03	.009	.03	.008	.04	.002	.03	.0.31	.01	.21	.09	<.001	.04	.001
Step 2[c] (ΔR^2, p)	.08	<.001	.07	<.001	.28	<.001	.08	<.001	.09	<.001	.21	<.001	.06	<.001	.08	<.001
Full model[d] (R^2 [R^2_{adj}], p)	.13 [.01]	<.001	.10 [.08]	<.001	.32 [.30]	<.001	.12 [.10]	<.001	.12 [.10]	<.001	.22 [.20]	<.001	.15 [.12]	<.001	.13 [.10]	<.001
Feeding Practices[e] (β, p)																
Persuasive Feeding	.18	.003	.26	<.001	.20	<.001	.19	.002	-.09	.13	-.17	.003	.17	.005	-.02	.76
Reward for Behavior	-.19	.002	-.12	.052	-.10	.062	.17	.005	.34	<.001	.21	<.001	.10	.11	.34	<.001
Reward for Eating	.19	.004	.08	.23	.30	<.001	-.04	.56	.01	.86	-.27	<.001	-.02	.78	-.11	.10
Structured Meal Setting	-.09	.10	-.01	.88	-.12	.013	-.01	.86	.05	.31	.16	.002	.08	.11	.002	.98
Structured Meal Timing	-.12	.023	-.04	.47	-.07	.14	-.10	.044	.03	.46	.12	.011	-.09	.076	-.04	.41
Family Meal Setting	-.03	.56	-.03	.60	-.31	<.001	-.01	.83	.04	.43	.24	<.001	-.06	.23	.002	.96

[a] from the Children's Eating Behaviour Questionnaire.[28] Mean scores for each subscale based on responses to items on a scale from 1 (low) to 5 (high).

[b] Covariates only model – Parent age, university degree (yes or no), child age, child gender.

[c] Feeding practices added to model.

457 [d] Covariates + Feeding practices included in full model.
458 [e] from the Feeding Practices and Structure Questionnaire (FPSQ-28[26]).
459 R^2: variance in the eating behavior explained by the model; ΔR^2: change in R^2; R^2_{adj}: adjusted R^2; β: standardized regression coefficient.