Research report

Mother–child feeding interactions in children with and without weight faltering; nested case control study☆

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A B S T R A C T

Aims: To explore whether the Mellow Parenting assessment system can detect any difference in parent–child meal time interaction between children with weight faltering (failure to thrive) and normally growing children. *Subjects and methods:* Thirty mother–infant dyads with weight faltering and 29 healthy controls nested within the Gateshead Millennium prospective cohort study were assessed at mean age 15.6 months (range 13–20). Video-tapes of two standardized meals per child by a researcher blind to infant health status were analysed using a simplified version of the Mellow Parenting Coding System (MPCS), an all events measure of maternal–child interactivity. These were linked to questionnaire data on eating behaviour and growth held on the children. *Results:* The MPCS had good inter-rater reliability (0.82) and coherent inter-relationships between coding domains. During case meals there were significantly fewer positive interactions overall: cases median 81.5 (IQR 4–496); controls 169.5 (40–372) and within all the commonly observed domains (Anticipation ($p = 0.013$), autonomy ($p = 0.003$), responsiveness ($p = 0.005$) and cooperation ($p = 0.016$)). There were only low levels of distress and control or negative behaviours and no significant differences were found in these between the groups. The case infants had significantly lower reported appetite by the age of 4 months and higher reported avoidance of feeding at the age of 8 months than controls. *Conclusions:* Mothers of weight faltering infants generally showed fewer interactions with their infants at mealtimes. It is not clear whether this is causal or simply a maternal adaptive response to their child's eating behaviour.

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Introduction

It is generally accepted that maternal child interaction is of high importance and it is in the process of feeding that this interaction is most readily evident. Chatoor argued that the feeding interaction is one which is central in establishing a parent's dyadic relationship with his or her child (Chatoor, 2000) and other authors have emphasized the importance of concepts such as "sensitivity" and "responsivity" (Ainsworth, Blehar, Waters, & Wall, 1978), "connectedness" and "mirroring" (Stern, 1985) in characterizing optimal parental interaction. Since feeding is such an important form of interaction, it has long been suggested that disruption of the

maternal child interaction may play a key role in the causation of weight faltering or 'failure to thrive'. This was particularly so early on, when studies in referred populations linked 'failure to thrive' closely to maternal disturbance or neglect (Oates & Hufton, 1977; O'Callaghan & Hull, 1978). A number of early studies also suggested that infants with 'failure to thrive' had higher rates of insecure attachment (Ainsworth et al., 1978; Gordon & Jameson, 1979) less physical and verbal interaction (Pollitt, Eichler, & Chan, 1975) and lower rates of maternal sensitivity, emotional expression, responsiveness, acceptance, and cooperation (Casey, Bradley, & Wartham, 1984; Drotar, Eckerle, Satola, Paclotla, & Wyatt, 1990). However these studies often used highly subjective definitions and most were of children referred for treatment, making selection bias likely.

In more recent years studies in unselected populations have found little evidence of a link between slow weight gain and maternal disorder (Boddy & Skuse, 1994; Drewett, Blair, Emmett, & Emond, 2004) or even poverty (Blair, Drewett, Emmett, Ness, & Emond, 2004; Wright, Waterston, & Aynsley-Green, 1994b). Few rigorous studies of maternal child interaction have been done in un-referred populations. One small study described mothers of cases as displaying more negative affect, and less likely to give

instructions, communicate or socialize at mealtimes (Hepinstall et al., 1987), but another larger population based study found no difference in the level of interaction (Skuse, Wolke, & Reilly, 1992).

Observational research focusing on general parent–child interactions has been shown to distinguish problem dyads (Dowdney, Skuse, Rutter, Quinton, & Mrazek, 1985; Mills, Puckering, Pound, & Cox, 1985; Puckering et al., 1995) but it is time consuming and demanding. A number of studies have used various mealtime observational schedules, but none are in widespread use. Probably the most widely used are the infant Feeding Scale (Chatoor et al., 1997) and the Cognitive Growth Fostering subscale of Nursing Child Assessment and Teaching Scale (Barnard, 1978). The Parent–Child Early Relational Assessment has also been used in at least two studies (Hutcheson, Black, & Starr, 1993; Black & Nitz, 1996), but is itself unpublished. The Bob and Tom Method of Assessment (BATMAN) (Klesges et al., 1983) has also been used in at least two studies. However these all rely on a global observation of the whole meal, an approach which tends to be culturally specific and is difficult to standardise.

The Gateshead Millennium Baby Study (GMBS) is a population based birth cohort, set up to study various aspects of feeding and growth prospectively (Parkinson et al., 2010). Work in the cohort as a whole has already demonstrated that weight faltering is not clearly associated with either maternal disturbance or poverty (Wright, Parkinson, & Drewett, 2006b) and that children with slow weight gain have lower appetite (Wright, Parkinson, & Drewett, 2006a). A case control study nested within this cohort set out to directly observe infant behaviour in infants with weight faltering. This used an existing all events coding scheme which describes a child's feeding behaviour in terms of feeding and eating acts (e.g., accept, refuse, give, self-feed) with high reliability (>0.87) (Drewett, Kasese-Hara, & Wright, 2003; Parkinson & Drewett, 2001). An earlier version of this scale had shown some differences in a population of children referred with failure to thrive compared to controls (Drewett et al., 2003). On this occasion no difference was found in the number of feeding acts between children with weight faltering and controls, but they did consume less energy (Parkinson, Wright, & Drewett, 2004).

However, this coding scheme only counted child and parent feeding acts and not the process or style of interaction, which might be expected to be more important. In seeking a measure of interaction we became aware of the Mellow Parenting system, an all events observational tool designed to examine parent–child interaction, which had been developed by CP. This has been used for assessment in a group intervention for parenting problems (Puckering, Evans, Maddox, Mills, & Cox, 1996; Puckering, Rogers, Mills, Cox, & Mattsson-Graff, 1994) but not for children with growth or feeding problems.

Aims

We thus set out to develop a shortened version of the Mellow Parenting system suitable specifically for use at mealtimes and then to use it to reanalyse the video-tapes from this study, both to explore it utility in this context and to explore whether interactive behaviour differs in children with weight faltering compared to controls. We hypothesized that, at mealtimes, parents of children with weight faltering would show fewer positive interaction and more negative interactions compared to controls.

Methods

Subjects

This was a nested case–control study within the Gateshead Millennium Baby Study (Parkinson et al., 2010) which recruited

1029 infants shortly after birth between 1 June 1999 and 31 May 2000. At recruitment baseline information was collected, including birth weight and socio-economic status. Routine baby clinic weights were then obtained via parental questionnaires, and infants were weighed at a health check at 12–13 months. Of the 1029 infants, 961 were born at 37 weeks gestation or later and were eligible for the present study.

Weight faltering was defined using conditional weight gain (the Thrive Index) (Wright, Avery, Epstein, Birks, & Croft, 1998; Wright, Matthews, Waterston, & Aynsley-Green, 1994a). In this study a baseline Z score (the average of the birthweight and any weights available between 4 and 8 weeks) was compared to the latest available weight Z score collected at 9–13 months. This difference was adjusted for baseline, to allow for the tendency of very large or small children to regress to the mean (Parkinson et al., 2004). Any child with weight gain below the 5th percentile for the cohort was defined as weight faltering and invited to participate. Controls were identified from a 10% random sample of the remainder of the cohort, provided they had a weight beyond the age of 9 months and their thrive index was above the 10th percentile. A birth weight and at least one weight between 9 and 13 months were available for 817 (85%) of the cohort members. Fifty-five children out of the 817 met the criteria for weight faltering. These 55 cases and 80 controls were approached, and 38 (69%) cases and 58 (72%) controls were successfully recruited. Eight cases and one control were excluded as the weight recorded at the home visit showed that they no longer fulfilled the criteria for participation, leaving 30 cases and 57 controls (Parkinson et al., 2004). Ethical approval was granted by Gateshead and Tyneside Local Research Ethics Committee.

Video data

Participants were studied (by KP) during two lunchtime meals aged 13–21 months in their own homes, generally on consecutive days, with their mother present. One was a finger food meal and one a spoon meal, with the order randomly counterbalanced. Commercially produced foods of known energy content were provided, selected by the mother from two lists. One comprised finger foods (e.g., fish fingers, chips and fruit) and the other spoon foods (e.g., mashed potatoes, spaghetti Bolognese and yoghurt) which the mother prepared and gave as usual; she also provided any drinks. Video recording began when the food was placed in front of the child and continued until the food was removed, or the meal was clearly over. All the video-tapes were viewed and analysed by KP in the original study of Parkinson et al. (2004) and then archived. KP played no part in the second phase of coding and there was no consultation with her about individual videos.

Procedures for this analysis

For this further analysis, the *control* video-tapes were randomly divided into two groups. The first of these was used (by JR) in developing and piloting the coding system. The second group of 29 control video-tapes were then supplied with the 30 case video-tapes to JR for the definitive study and she remained blind to their case–control status till all the ratings were completed.

Measures

The measure used in this study was a simplified version of the Mellow Parenting Coding System (Puckering et al., 1994) which summarizes the dyadic relationship between parent and child and the emotional tone and content of the relationship. It was developed from a reduced version of the Newpin Coding System

Table 1
Simplified domains of the Mellow Parenting System used to code parent's interactional behaviour at mealtimes.

	Positive	Negative
Anticipation	Prepares the child for changes in activity or care-taking	Does not prepare child then complains
Autonomy	Shows awareness of child's individuality, wishes, needs timing	Is intrusive or dismissive of the child's point of view
Responsiveness	Expresses warmth to the child, able to 'mesh' with the child	Expresses, criticism, smacking, shouting, rough handling
Cooperation	Influences the child's behaviour by persuasion or distraction or other non-confrontational means	Harsh demands, threats or negative responses to the child's requests
Distress	Positive containment of child's distress	Punitive response, precipitates the distress or fails to support a distressed child
Control	Seeks to achieve compliance from the child legitimately and effectively	Unsuccessfully or inappropriately seeks to achieve compliance

(Cox et al., 1991) with the observational measures derived from the literature and previous research in the parenting field. The codes have been validated experimentally, showing coherent interrelationships and a correspondence with child behaviour problems (Cox, Puckering, Pound, & Mills, 1987).

The method uses all events coding: each 10-s interval of video footage is viewed and all observed interactions are coded into one or more of 6 domains, each of which can be positive or negative (Table 1). JR was trained in the use of the original Mellow Parenting Coding System by coding video-tapes of parent–child interactions in a variety of settings including play, mealtimes, and other caregiving situations until 85% inter-rater reliability with a trained observer was achieved. A pilot study was then undertaken using 14 of the GMBS control video-tapes allocated to the development group. At this stage, low frequency codes were deleted to produce a simplified version.

JR then used the simplified coding system to code the 30 weight faltering and remaining 29 healthy control video-tapes, while remaining blind to their case control status. A random sample of 5 tapes was also coded by CP (also blind to group status) to assess inter-rater reliability.

In addition to the Mellow Parenting coding, there were data already held on the meals, including energy intake, meal duration, length and weight at assessment. These were also linked to questionnaire data collected for the children as part of the larger study, including parental socio-demographic data, maternal Edinburgh Postnatal Depression Scale (EPDS) (Cox, Holden, & Sagovsky, 1987) and the Dutch Eating Behaviour Questionnaire (DEBQ) (van Strien, Frijters, Bergers, & Defares, 1986), as well as parental rating of appetite at 6 weeks 4 and 8 months and scores of parental response to food refusal (with encouragement, other food or extra meals) and child feeding avoidance (based on number and

frequency of avoidant behaviours) at age 8 months which have been described elsewhere (Wright, Parkinson, & Drewett, 2006a).

Data analysis

Total count data for each of the two meals were combined. As the count data were not normally distributed, they were log transformed and *t*-test used to compare the geometric means per group. For the comparison of Haredi and non Haredi cases, because of the small numbers, Mann Whitney *U* test was used. Inter-rater reliability was assessed using Cohen's Kappa and correlation between domains assessed using Spearman's rho. Using pre and post group means from Puckering et al. (1994) the 30 cases and 29 controls available were predicted to give 80% power at 5% level to detect differences of the order of 0.73 SD between the groups.

Results

All 30 cases and the randomly selected 29 control videos were studied, but 1 control infant had only one recorded meal sequence, so that only 28 were used. The finger meals lasted a mean (SD) of 22.0 (7.3) min and the spoonable meals 14.5 (5.2) min. The mean age of children at assessment was 15.6 months (range 13–20). Birth weight for the two groups was similar but, as expected, the weight and Thrive Index at the time of assessment were significantly different (Table 2). None of the children in either group had a history of major morbidity and none were or had been tube fed. Within the case group 5 (17%) children were members of a Haredi (ultra orthodox) Jewish community based in Gateshead, while none of the controls were from this community. Only 3% children in the cohort as whole were Haredi and their high rates of

Table 2
Characteristics of case and control children studied. The figures show the mean (SD) or percentage (*n*). †Haredi versus other cases. ‡All case versus controls.

	Non Haredi cases		Haredi cases		*P t* test†	Controls		*P t* test‡
Number	25		5			29		
	Mean	SD	Mean	SD		Mean	SD	
Birth weight in *Z*-scores	0.01	1.0	0.72	0.8	0.16	0.01	1.0	0.5
13–21 month weight *Z*-score	−1.86	0.7	−1.41	0.3	0.17	0.20	0.8	<0.001
13–21 month Thrive Index	−1.77	0.4	−1.85	0.3	0.67	0.20	0.8	<0.001
Child's age at first meal, in months	16.0	1.6	15.6	1.7	0.67	15.3	1.2	0.1
Age weeks first solids	14.7	1.2	27.5	6.6	<0.001	14.3	1.7	0.024
Mother's age	28.5	5.8	35.2	7.5	0.03	28.7	5.7	0.58
	%	N	%	N	*P*† χ^2	%	N	*P*‡** χ^2
Males	40	10	80	4	0.16	48	14	0.55
First born	36	9	0		0.09	55	16	0.08
Breastfed ever	68	17	100	5	0.29	57	16	0.27
Wage earner in family	80	20	75	3	1	75	22	0.5
Own home	76	19	100	4	0.55	55	16	0.12
Own car	80	20	40	2	0.1	73	22	0.58
Edinburgh Maternal Depression score >12	16.9	4	20	1	1	17.9	5	0.61

Table 3

Inter correlation between positive domains with counts greater than two values are Spearman's Rho correlation coefficients; all significant at $p < 0.001$.

	Autonomy	Responsiveness	Cooperation
Anticipation	0.63	0.71	0.71
Autonomy		0.67	0.65
Responsiveness			0.73

weight faltering have been discussed elsewhere (Wright, Stone, & Parkinson, 2010).

Four positive maternal interactive behaviour domains occurred commonly during the meals: median (IQR) score for whole group: anticipation 11 (5–17.25); autonomy 24 (12.75–43.75); responsiveness 38.5 (20–61); cooperation 35.5 (20.5–61). The Distress domain was recorded infrequently and never observed in 52% children, while Control was noted only once each in 2 children. Negative behaviours were observed very infrequently across all domains. Even when these were summed to give a single combined negative interaction variable, 31 (53%) children had no instances and only three had more than five. Significant, moderate inter-correlations were observed between the four common positive domains (Table 3). Inter-rater reliability was acceptable (Cohen's Kappa = 0.82).

Compared to controls, cases had significantly lower counts for all the common positive domains (Table 4). The total of all

Table 5

Counts for all domains for Haredi and other case families, compared to controls.

	Median	Range	P^*
Anticipation			
Haredi cases	1	0–15	0.047
Other cases	7	0–45	0.032
Controls	13.5	4–33	
Autonomy			
Haredi cases	14	0–29	0.025
Other cases	16	5–78	0.010
Controls	33	5–90	
Responsiveness			
Haredi cases	9	2–55	0.007
Other cases	27	8–201	0.025
Controls	61.5	7–215	
Cooperation			
Haredi cases	22	1–43	0.016
Other cases	29	2–172	0.057
Controls	50.5	9–121	
Total positive			
Haredi cases	50	4–140	0.006
Other cases	84	22–496	0.009
Controls	169	40–372	

* Mann Whitney compared to controls.

Table 4

Counts for all domains for cases compared to controls.

	Median	Range	Geometric mean	Geometric mean difference	P t-test
Positive interactions					
Anticipation					
Cases	6.5	0–45	6.2	6.54	0.004
Controls	13.5	4–33	12.8		
Autonomy					
Cases	15.5	0–78	16.1	13.5	0.005
Controls	33.0	5–90	29.5		
Responsiveness					
Cases	25.5	2–201	28.1	23.9	0.008
Controls	61.5	7–215	52.0		
Cooperation					
Cases	26.5	1–172	25.6	18.7	0.018
Controls	50.5	9–121	44.3		
Distress					
Cases	0	0–26			
Controls	0.5	0–12			
Control					
Cases	0	0–1			
Controls	0	0–2			
Total positive					
Cases	81.5	4–496	79.2	69.4	0.003
Controls	169.5	40–372	148.5		
Negative interactions					
Anticipation					
Cases	0	0–1			
Controls	0	0–1			
Autonomy					
Cases	0	0–1			
Controls	0	0–4			
Responsiveness					
Cases	0	0–2			
Controls	0	0–4			
Cooperation					
Cases	0	0–1			
Controls	0	0–6			
Distress					
Cases	0	0–4			
Controls	0	0–8			
All negative					
Cases	0	0–5	0.53	0.53	0.115
Controls	1	0–15	1.06		

Table 6
Previous questionnaire responses for case families compared to controls.

Questionnaire item	Age item asked	%	N	%	N	%	N	P[*]
Child appetite	6 weeks	Very good		Good		All right or worse		
All cases		70	19	30	8	0		0.22
Cases excluding Haredi		70	16	30	7	0		0.22
Controls		83	20	17	4			
Child appetite	4 months							
All cases		41	11	52	14	7	2	0.015
Cases excluding Haredi		30	7	61	14	9	2	0.003
Controls		79	19	17	4	4	1	
Child appetite	8 months							
All cases		42	11	39	10	19	5	0.007
Cases excluding Haredi		36	8	41	9	23	5	0.003
Controls		86	18	10	2	5	1	
Maternal response to food refusal		Low		Medium		High		P[*]
All cases	8 months	15	4	69	18	15	4	0.11
Cases excluding Haredi		9	2	73	4	18	4	0.031
Controls		25	5	75	15	0		
Child avoidance of feeding		Low		Medium		High		P[*]
All cases	8 months	18	5	43	11	39	28	0.015
Cases excluding Haredi		17	4	38	11	46	11	0.009
Controls		43.5	10	43.5	10	13	3	

[*] χ2 trend versus controls.

negative interactions was also slightly lower for cases than controls, but this difference was not significant. Haredi infants were greatly overrepresented in the case group and when the above analyses were rerun separately, Haredi case infants had even lower scores than the other cases (Table 5). However, although the differences diminished slightly for non Haredi cases, they remained significant for Anticipation, Autonomy and Responsiveness, while Cooperation still had borderline significance (Table 5).

In the questionnaires returned for the whole cohort, parents had rated case children as having significantly lower appetite from age 4 months and rated them at age 8 months as showing significantly higher food avoidance (Table 6). Mothers of non Haredi cases also responded significantly more to food refusal (Table 6). Neither Townsend Deprivation score, or maternal DEBQ or EPDS score had any modifying effect on these results.

Discussion

The main findings of this study were that the Mellow Parenting scheme identified significant differences between mothers of weight faltering children and controls, with nearly twice as many positive interactions in meals eaten by controls, compared to weight faltering children. The strengths of this study are that it used a carefully developed and well standardised rating scheme with rating performed blind. The weight faltering cases and controls were identified by screening from within a representative birth cohort, thus avoiding selection bias. The study also used an objective, reproducible, well validated definition of slow weight gain, which is unconfounded by size at birth. A limitation is that the children predominantly had only mild to moderate weight faltering, with none severe enough, for example, to have been admitted to hospital for investigation or to be tube fed. That being so it is striking that such large differences between the groups could be detected, particularly as we know from earlier analyses that the number of simple feeding and eating acts (offer, accept, refuse etc.) did not show significant differences between the groups (Parkinson et al., 2004). If this study were to be repeated with more severe cases it is possible that a different pattern of interactions would be seen, since

parents under hospital followed up for weight faltering are likely to be more anxious. For example in our study negative interactions were so infrequent as to be of minimal impact, but a previous study found more negative and coercive interaction in referred children with feeding problems (Sanders, Patel, Le Grice, & Shepherd, 1993). Some of our findings are compatible with one previous study of interaction in community screened children. That study used blinded, standardized home observations of mealtime situations and rated case mothers as being less likely to give instructions, communicate or socialize at mealtimes (Hepinstall et al., 1987). However a later larger study from the same group found no differences in interaction at all (Skuse et al., 1992).

Our cases mothers appear to be in less positive relationships with their infants than the control group. Although only observed during meal time, the commonly occurring scores, positive autonomy, anticipation, responsiveness, and cooperation are the key constructs identified in previous observational research as being important to all mother-child interaction (Ainsworth et al., 1978). Three of these dimensions, Anticipation, Autonomy, and Responsiveness, taken collectively could be described as maternal sensitivity: the ability of the parent to perceive signals accurately and respond to them promptly and adequately. This would suggest that in the current study, control mothers exhibited higher levels of maternal sensitivity than case mothers. This would be in keeping with a prospective study where feeding problems at age 2 years were predicted by the interaction between infant temperament and lower maternal sensitivity (Hagekull et al., 1997).

While it is tempting to simply draw the inference that the case children were weight faltering because of their mother's low engagement at meal times, an alternative explanation is that the case mothers have adopted this behaviour as a response to their child's eating behaviour. A limitation of the Mellow Parenting system, in common with most other attempts to characterize maternal-child interaction, is that it primarily describes maternal responsiveness. We thus know little about how the child behaved during the meal, apart from the observation recorded previously that the weight faltering children were less likely to stay in their high chair throughout the meal (Parkinson et al., 2004). However,

we do have questionnaire information on these children dating back to young ages. While the behavioural information is limited, we know that a majority of case mothers were already rating their children as having relatively low appetite as early as 4 months. At 8 months, 2–6 months before these meals were observed, mothers were reporting significantly more feeding avoidance by the children and that they were more likely to respond to their child's food refusal with encouragement, other food or extra meals. It thus seems possible that this lack of interaction is appropriately responsive, rather than causal, as we have previously described how this response to food refusal seemed to be associated with worse weight gain, even after adjusting for appetite (Wright, Parkinson, & Drewett, 2006a). Only an intervention study could clarify whether this lack of maternal interaction is responsive and whether it is helpful or in fact maladaptive. Meanwhile further work is planned to explore the child's (as opposed to maternal) behaviour during these meals.

Children from Haredi (ultra orthodox) Jewish families were greatly overrepresented in the case group. Demographically these children were very different from the other cases and controls. In the cohort as a whole the Haredi infants generally had much poorer growth and this appeared to relate mainly to large family size and late weaning (Wright, Stone, & Parkinson, 2010). Haredi infants did have the lowest domain scores of all, but the differences between cases and controls remained substantial even when they were excluded. It is of note that the differences in reported appetite and feeding avoidance between cases and controls were greater for the non Haredi mothers, suggesting that the Haredi mothers may have been less aware of their child's slow weight gain.

This analysis has also demonstrated the power of the Mellow Parenting system to detect complex, yet meaningful differences in the emotional tone and style of maternal interaction, that were not detected by simply counting feeding behaviours. While it is a complex and labour intensive coding system, it could be of great value in specialist feeding clinics, where meals are often video-taped. In these settings there is a need for standardized assessment and recording schemes, in particular to evaluate response to treatments. These finding also suggest that there is value in examining the emotional tone and context of meals, rather than simply counting feeding acts or nutrient intake.

Conclusions

This analysis has demonstrated a substantially less maternal interaction at mealtimes with weight faltering children compared to normally growing children. These children also seem to have long standing behavioural characteristics that may themselves have influenced their mothers' interactional style. It is thus not clear whether this is causal or a maternal adaptive response to their child's eating behaviour.

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