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Research Report

Feeding behaviour in young children who fail to thrive

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Abstract

One-year-old children who failed to thrive in infancy were identified through a specialist clinical service using a conditional weight gain criterion which identified the slowest gaining 5%. Control children of the same age and sex were recruited from the same local geographical area and had the same primary care physician. The food intake and feeding behaviour of the groups was compared using a detailed observational micro-analysis of a lunchtime meal, using a behavioural coding scheme developed for use over the weaning period.

Both food and fluid intake at the test meal were significantly lower in the children who failed to thrive than the controls. There was no significant difference in the energy density of the foods they consumed. As recorded in the behaviour counts at the meal, the mothers of the children who failed to thrive fed them as much as or more than the control mothers fed their children. The children who failed to thrive tended to refuse or reject the offered food more, and also fed themselves significantly less often than the controls. These behavioural differences during the meal accounted for about one third of the difference in energy intake between the groups.

Keywords: Failure to thrive; Feeding behaviour; Infant; Weight gain

1. Introduction

Failure to thrive is a term generally used to describe children whose weight gain is poor in infancy or early childhood (Frank and Zeisel, 1988; Maggioni and Lifshitz, 1995). Poor weight gain can reflect an underlying medical condition (Reilly and Skuse, 1992; Philpot et al., 1999; Giglio and Cnadusso 1997). In most infants it does not; in a 1 year birth cohort in Newcastle-upon-Tyne, for example, no underlying medical condition could be identified in more than 90% of children who failed to thrive in the first 18 months (Drewett et al., 1999). The aetiology is then generally referred to as 'non-organic', though this is a rather too general term: there is no justification for assuming that there are no organic causes of variability in weight gain other than those that can be identified as physical illnesses.

While it is reasonably clear that non-organic failure to thrive is attributable to low food intake by the affected children (Whitten et al., 1969; Frank and Zeisel, 1988; Maggioni and Lifshitz, 1995), it is far from clear *why* their food intake is low. Failure to thrive is not generally associated with child abuse or neglect (Kotelchuck, 1980; Mitchell et al., 1980; Skuse et al., 1995; Wright et al., 1998) and it is not strongly associated with poorer environmental circumstances (Wright et al., 1994). Feeding problems, however, have been consistently reported to be more common in children who fail to thrive (Pollitt and Eichler, 1976; Iwaniec and Herbert, 1982; Kotelchuck and Newberger, 1983; Altemeier et al., 1985; Mathisen et al., 1989; Tolia, 1995; Wilensky et al., 1996; Drewett et al., 1999; Wright and Birks, 2000). These reports are generally derived from interviews with the mothers of children who fail to thrive, and the problems need to be investigated using direct measures of feeding behaviour.

The identification of failure to thrive depends on slow weight gain over a reasonably extended period, and although weight gain can be poor from birth (Drewett et al., 1999) cases are often not firmly identified clinically until they are about a year old. Behaviourally this is still in the weaning period, in which infants are in a transitional stage, partly feeding themselves and partly being fed by their mother or another carer, often at the same meal (Parkinson and Drewett, 2001). Young and Drewett (2000)

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and Parkinson and Drewett (2001) have formulated a coding scheme for the description of mealtime feeding behaviour over the weaning period, with codes to describe both independent feeding and being fed by an adult. Our aim in this study was to compare feeding behaviour at the test meal in children who failed to thrive and appropriate controls and to examine the extent to which differences in their behaviour explained differences in their energy intake.

2. Method

2.1. Subjects and procedure

Twenty-eight children who failed to thrive and 28 controls of the same age and sex and from the same geographical area were recruited through a specialist clinical service for a study of energy compensation as described in Kasese-Hara et al. (2002). All cases referred to the service over a 2 years period were eligible for study if they met a conditional weight gain criterion (Healy, 1974; Cole, 1995). In relation to an appropriate reference population (UK 1990 standards: Freeman et al., 1995; revised Preece et al., 1996), this identified children with weight gain in the slowest 5% compared with children of the same weight soon after birth (Wright et al., 1994). Recruitment was restricted to children aged 12–24 months at the time of the investigation. The control group comprised 28 children with normal growth identified through the District Child Health Register. They were recruited to be comparable with cases in age and sex, with the same primary care physician and resident in the same local geographical area. Of these families 27 case and 27 control families agreed to take part in the study, though one control family would not agree to the video recording, and intake data from a different control was not available owing to an error.

For each child a standard lunchtime meal was videotaped using a SanyoVM-EX20P VCR. The meal replaced a normal lunchtime meal and was given in the usual way in the child's own home. The aim was to give a limited range of foods, the same for each child, that would normally be acceptable to children of this age. The meal comprised a variety of snacks served at room temperature (the same for all the children). The snacks were: potato chips; potato rings; cheese singles; sandwiches made up with white, medium sliced bread, low-fat spread and tuna and mayonnaise paste, cheese paste, or marmite; carrot sticks; cucumber slices; fromage frais; jelly; orange drink; black current drink. Digital scales (OHAUS GT4800) were used for weighing food before and after the meal accurate to 0.1 g, and the energy density of the foods was known, making it possible to calculate energy intake. The meal was preceded by a standard drink of orange or blackcurrent juice of low energy content (0.8 kJ in 150 ml). The children drank this ad libitum over the half hour before the meal. A meal on another day was also studied, preceded by a high energy drink. Data from this meal are not reported as the children were partly satiated and their feeding behaviour was altered as a result (Kasese-Hara et al., 2002).

2.2. Analysis

The videos were analysed on a Pansonic AG-6040 time lapse VCR using purpose written software (Marsh, 1988). Analysing feeding behaviour in children of this age is complex. It can involve different types of food (liquids, purees or solids; sweet or savoury) and different feeding methods (bottles, cups or feeders, spoons or fingers and hands). Codes were used for each of these, together with the specific behaviour codes given in Table 1. Children can feed themselves or be fed by an adult; when fed by an adult they can accept or refuse the food. These behavioural acts, together with the type of food chosen, determine energy intake over the course of the meal. Continuous sampling (Martin and Bateson, 1986) was used, giving a complete record of each of each act over the course of the meal. Each of the behavioural variables was used in the analysis in the form of counts over the meal. The *duration* of the meal was defined as the time from the first coded feeding act to the last.

In order to establish the reliability of the codes used one of the authors coded 30 meals chosen at random, and they were recoded independently by another experimenter experienced with the coding scheme. All the video tapes were then coded by two independent coders, who were not otherwise involved in the research in any way and who were blind to the child's clinical group (case or control). Other than for the reliability correlations, all the analyses used these independent codings. Non-parametric methods, *t*-tests or regression methods were used for data analysis as appropriate, in SPSS (version 10).

Table 1
Behaviour codes used in the coding of mealtime behaviour

Actor	Act	Brief definition
Child	Feedself	Child grasps food (spoon, etc) and brings it to mouth
Adult	Hands	Adult places food in child's hand
Adult	Gives	Adult brings food to child's mouth
Child	Accepts	Child takes food from spoon or adult's hand into mouth
Child	Refuses	Child will not open, or closes, mouth in response to a give; or will not take food in response to a hand
Child	Rejects	Child expels food or drink from mouth; or hands back food; or throws food

Codes to signify that the child's behaviour was not visible and error correction codes were also available and were used as necessary.

3. Results

3.1. Case and control children

The mean (SD) age of the cases whose food intake was recorded was 17.4 (3.6) months and of the controls 18.3 (4.0) months ($t = 0.9$, NS). Fourteen of the cases were boys (52%) and fifteen of the controls (58%); $\chi^2 = 0.18$, NS. The mean (SD) weight of the cases in kg was 3.14 (0.69) at birth and 9.06 (1.05) at the time of the study; in controls it was 3.42 (0.43) at birth and 11.59 (1.59) at the time of the study. The first difference is not statistically significant ($t = 1.75$, NS); the second is ($t = 6.87$, $p < 0.001$), reflecting the poor weight gain of this group over the first year.

3.2. Energy intake and meal duration

Table 2 shows that intakes of both solid food and drink were significantly lower at the meal in the cases than in the controls. This difference was principally due to differences in the quantities (mass) taken. The cases did take slightly less energy dense foods, but this difference was not statistically significant. Three of the 26 controls and six of the 27 cases took no drink; the difference was not statistically significant by Fisher's exact test. The mean duration of the meal (defined as the time from the first feeding act to the last) was significantly shorter in the case group (by 5.6 min, 17% of the duration of control group meals).

3.3. Feeding behaviour

Non-parametric correlations (Spearman's ρ) between the observers for the count of each variable at the 30 meals that were coded twice for reliability were as follows: *feedself*.9, *hands*.8 and *gives*.8; *accepts*.7, *refuses*.8 and *rejects*.6.

Table 2
Intakes of solid foods and of fluids in cases (children who failed to thrive) and controls at a test meal

Variable	Cases		Controls		$t[z]$	$p <$
	Mean	SD	Mean	SD		
Intake, mass (g)						
Solid food	95.7	41.9	127.8	51.7	2.5	0.02
Drink	21.3	37.8	70.1	63.3	[2.84]	0.005
Intake, density (kJ/100 g)						
Solid food	709.3	232.5	757.1	169.4	0.85	0.4
Drink	162.5	68.4	194.5	57.8	1.67	0.2
Intake, energy (kJ)						
Solid food	645.4	284.4	925.6	352.3	3.19	0.003
Drink	40.8	92.1	136.7	138.1	[2.85]	0.005
Meal duration (min)						
	26.9	8.0	32.5	11.8	2.0	0.05

Data are summarised as means and standard deviations. Comparisons of the groups were carried out with *t*-tests except where the distribution were skewed, when z statistics (in square brackets) come from the Mann–Whitney *U* test. Energy densities were calculated for the foods actually eaten, and *N* was 27 for cases and 26 for controls except for drink density, where it was 21 and 23, respectively, as not all children took drinks.

Table 3
Counts of behaviour codes recorded for cases (children who failed to thrive) and controls at a test meal

Variable	Cases		Controls		z	$p <$
	M	*Q*	*M*	*Q*		
Feedself	46	23–84	63	38–92	2.03	0.04
Hand	3	1–5	1	0–4	2.15	0.03
Give	23	9–39	13	2–29	1.5	0.2
Accept	13	3–28	9	2–22	1.17	0.3
Refuse	6	3–14	3	1–8	1.95	0.05
Reject	6	1–10	3	1–8	1.31	0.2

Data are presented as medians (*M*) and quartiles (*Q*) as they were generally skewed. *N* was 27 for cases and 26 for controls. Test (z) statistics come from the Mann–Whitney *U* test.

Table 3 show the counts for feedself, hand and give, accept, refuse, reject. The distributions are presented as medians and quartiles as they were generally skewed. The case mothers handed their children food (hand) significantly more often (though for both groups this behaviour was infrequent). They also presented food directly to the child's mouth (gave food) more often, though the difference was not statistically significant.

As regards the children's responses to feeding by the mother, refuse and reject were more frequent in the cases than the controls; the difference in the first was close to statistical significance. However, the cases also accept food more. These are both responses to the mother's food offering behaviour, which was more frequent in the case group. In children whose give count was greater than zero ($n = 47$), the ratios of refuse to give were 0.42 (SD 0.26) and 0.30 (SD 0.23) for cases and controls, respectively. So cases on average refused offered food more, though the difference was not quite statistically significant ($t = 1.71$, $n = 45$, $p = 0.09$, two-tailed). The cases fed themselves (feedself) significantly less often than the controls (Table 3).

3.4. Feeding behaviour and energy intake

Hierachical linear regression was used to assess the extent to which the observed differences in energy intake could be explained by the observed behaviour.

Table 4 shows a simple sequential model relating energy intake to feeding behaviour during the meal. At the first stage (Model 1) energy intake is related to a constant and a term coding for group; the coefficient associated with this term (-390.0) is the difference in the energy intake between the two groups in kJ. At the second stage the food density (energy density of the food chosen in kJ/100 g) was entered. This variable had a small effect of marginal statistical significance.

The variables used on subsequent steps were those immediately related to the child's actual ingestion of

Table 4
Relationships between behaviour counts and energy intake from solid foods at test meals in cases (children who failed to thrive) and controls

Model	R	F_{change}	$p <$	Coefficient for group
1. Constant + group(FTT)	0.46	13.6	0.002	−390.0
2. Constant + food density	0.5	2.4	0.2	−371.5
3. Constant + feedself	0.61	8.7	0.006	−311.8
4. Constant + give, refuse, reject	0.73	5.2	0.004	−280.1
Variable	β	SE	t	$p <$
Constant	257.1	229.9	1.12	0.3
Group (FTT)	−280.1	91.4	−2.70	0.005
Food density	0.5	0.3	1.98	0.06
Feedself	5.9	1.7	4.14	0.002
Give	13.0	3.6	3.30	0.002
Refuse	−21.4	9.6	2.10	0.04
Reject	−14.0	6.9	1.48	0.05

The statistics come from four models analysed by forward regression with the variables indicated added on each step. R, F and p are the multiple correlation coefficient, the F statistic for the change from the previous model, and the associated p value, respectively. Also shown is the coefficient for *group* estimated for each model; the reduction in this shows the extent to which differences in the groups are accounted for by the other variables. Dependent variable: food intake (kJ). $F_{(6,45)} = 8.44$, $p < 0.001$; $R = 0.728$; residual SD = 310.6.

food at the meal, i.e. the counts of feedself, give, reject and refuse (accept was not included as it is inversely related to refuse—the child either accepts or refuses what the mother gives). There were the strong relationships one would expect between the counts of feedself, give, and the child's energy intake during the meal. There was also an effect in the expected direction of refuse which was statistically significant, and an effect in the expected direction of reject, though this only approached statistical significance ($p \approx 0.1$); the lack of a clearer effect may be partly because reject had a rather low reliability (0.6) compared with the other predictor variables (0.8–0.9).

However, there remained a considerable unexplained difference between the groups. The initial unexplained difference in food intake between the groups in the regression was 390 kJ. The final unexplained difference was 280.1 kJ. So about a quarter of the difference in energy intake between the groups can be explained by observed differences between the feeding behaviour of the groups at the meal, but no more. Further analyses showed that the child's age, sex and weight had no statistically significant effect when these variables were added together to the models of Table 4. $F_{(3,43)}$ was 0.771, $p > 0.1$.

4. Discussion

Although reports that infants and young children who fail to thrive are difficult to feed have been published for the last 25 years, this is the first detailed micro-analysis of feeding behaviour itself in this condition, and the main strength of the study is in its detailed direct observation of behaviour. A structured standardised meal was used. This has the advantage that the same meal was offered to all children, but the disadvantage that it is unlikely to correspond to the normal meal of any of the children, though it was planned around foods that children of this age normally like. The case and control children were similar in age, and all between 1 and 2 years old. A coherent uniform growth criterion was used to select the cases. The cases did, however, come from a clinically referred population, and it is possible that there were biases in the referral process—for example, a greater tendency to refer children who the mother found difficult to feed.

Although the children in the two groups were of the same average age, the differences in food and drink consumed at the meal by cases and controls were striking (Table 2). Proportionally the difference in intake in the present study was greater for the fluids; the failure to thrive group drank less than half as much as the controls, whereas their food intake was 70% of the controls. The difference in the intake of fluids might repay further attention. In the UK drinks provide 23% of total daily energy intake in pre-school children (Watt et al., 2000; Gregory et al., 1995). The meals were significantly shorter in the cases, replicating the finding of Mathisen et al. (1989) in children of about the same age.

The foods provided for the children in the two groups were identical, and the foods (and drink) actually consumed were not significantly different in energy content, so the difference must be attributed principally to differences in the mass of food eaten rather than to differences in its energy density. The mothers of the case children attempted to feed their children as much as or more than the mothers of the control children: they *handed* the case children food significantly more often, and also *gave* the children food more often (i.e. put it directly to the mouth). The greater number of refusals is

partly explained by this, as there were more occasions on which it was possible to refuse. The ratio of refusals (to give) was higher in the cases, though the difference was not statistically significant. But the case children also fed themselves (feedself) significantly less often. Analysis of the relationships between the counts of the observed behavioural variables and the child's energy intake show that they were significantly related, the counts accounting for about a quarter of the variance in the child's energy intake (28%; entered before entering food density and group they accounted for 37%). The remainder is presumably accounted for by a lower intake per bite; some children with FTT, for example, have subtle oral-motor problems (Mathisen et al., 1989; Reilly et al., 1999).

To summarise, measured directly at a single feed children who fail to thrive took in substantially less energy than control children of the same age, principally because their food intake was low, rather than because they chose less energy-dense foods. Mother attempted to feed them at least as much a control mothers, but the children fed themselves less, and refused food offered by the mother more often. The differences in the food intake of the cases and controls, therefore, appear predominantly to reflect differences in the child's behaviour rather than in the mothers'. The children who failed to thrive in this study were recruited through a specialist clinical service, however, and the extent to which these findings can be generalised to other children who fail to thrive remains to be determined.

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