Observation and comparison of mealtime behaviours in a sample of children with avoidant/restrictive food intake disorders and a control sample of children with typical development

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Objectives: Despite widespread use of behavioural observations to evaluate child feeding behaviours in research and clinical practice, few studies have comprehensively characterised mealtimes or identified features that differentiate children with and without disordered feeding; these were the aims of the current study.

Methods: Mealtime observations were conducted for 18 children with Avoidant Restrictive Food Intake Disorder (ARFID) and 21 typically developing children. Observations were coded inductively, and associations between disorder and observed mealtime actions were examined.

Results: Most behaviours were observed across both clinical and non-clinical mealtimes, and many did not differ in frequency between children with and without ARFID. However, significant group differences were observed in the frequencies of behaviours relating to food intake, visual and physical engagement with feeding, and movement during mealtimes.

Conclusions: The comparability of behaviours across clinical and non-clinical groups suggests that eating behaviours exist on a continuum from 'normal' to 'abnormal', with group differences relating to frequency rather than type of behaviour. The behavioural differences observed in this study suggest that identification of children with ARFID should focus on child engagement with food and restlessness during mealtimes. Reliance on emotional and escape-maintained behaviours will lead to under-recognition of families in need of clinical support.

Key words: Behavioural Observation, Child Feeding, Eating Behaviours, Avoidant/Restrictive Food Intake Disorder

Introduction

Avoidant Restrictive Food Intake Disorder (ARFID) in childhood has, in the past, been studied using relatively simplistic characterisations of disorder (e.g., organic versus nonorganic aetiology). However, contemporary literature substantiates the complex and ambiguous nature of food avoidance and the numerous physical, social/emotional, and behavioural factors that are intimately associated with both disordered and typical feeding development (Dovey, Isherwood, Aldridge & Martin, 2010; Douglas, 1995; Silverman, 2010; Field, Garland, & Williams, 2003). This complexity has resulted in a lack of consistency in identifying and managing/treating ARFID within clinical and scientific communities.

Recent updates to official diagnostic criteria, including the re-labelling of feeding disorders as Avoidant/Restrictive Food Intake Disorders (ARFID) in the DSM 5 (2013) reflect the breadth and heterogeneity of the condition. Furthermore, the ARFID title underlines the relevance and importance of the child's approaches to food/eating (avoidant/restrictive) as well as what the child eats. The DSM now recognises a broader range of characteristics relating to eating disturbance, which may increase the rate of individuals meeting diagnostic criteria for an eating/feeding disorder (Eddy et al., 2015). However, ARFID is still a relatively new diagnostic category, and as such, specific and validated outcome measures, and robust population estimates of prevalence, from which to assess this assertion, are currently lacking in the literature (Norris, Spettigue & Katzman, 2016; Zickgraf, Franklin & Rozin, 2016; Tsai, Singh & Pinkhasov, 2017). Despite improved awareness and understanding of complex feeding disorders, there remains widespread under-diagnosis of disordered feeding due to the reliance on out-dated diagnostic criteria pertaining to weight loss/poor growth (Bryant-Waugh, Markham, Kreipe, & Walsh, 2010), and a lack of widespread knowledge and recognition of ARFID across healthcare services (Katzman, Stevens & Norris, 2014; Norris & Katzman, 2015; Tsai, Singh & Pinkhasov, 2017).

Poor intake, including number of food bites or volume of food eaten and associated avoidant behaviour towards food and/or mealtimes (Arvedson, 2008; Binnendyk & Lucyshyn, 2009; Casey et al, 2009; VanDalen & Penrod, 2010; Woods, 2010) have been consistently observed in home and laboratory studies. This suggests that reduced food intake is a key characteristic of disordered feeding behaviour in childhood, and indeed an ARFID diagnosis will be unequivocal in children requiring supplementary or total tube-feeding in the absence of physical cause. However, a great many additional psychological, social, and emotional factors have also been associated with disordered child feeding (Berlin et al., 2009; Black, 1999; Bryant-Waugh et al., 2010; Chatoor et al, 1998; Piazza, 2008; Sanchez & Castillo-Duran, 2004; Stein et al., 1999). This suggests that neglecting other factors in favour of physical attributes omits a population of children with disordered feeding from assessment and treatment, simply because they are managing, at that time, to maintain weight/growth, often via alternative, undesirable methods such as excessive milk intake or high calorie-low nutrient diets (Bryant-Waugh et al., 2010).

The purpose of the current study was to identify mealtime characteristics, via behavioural observations, that delineate ARFID feeding behaviour from normative feeding behaviour. Behavioural observation is a cornerstone of clinical assessment and diagnosis for ARFID, and the prevalence of studies utilising observational methodologies highlight their value in assessing and quantifying feeding behaviours within research (e.g., Ammaniti et al, 2004; 2010; Chatoor et al, 1998; Cooper et al, 2004; De Moor et al., 2005; Farrow & Blissett, 2006; Greer et al, 2008; Harris, 2009; Ramsay et al, 1993; Stein et al, 1999; Whelan & Cooper, 2000; Woods et al, 2010). However, continued under-identification of ARFID suggests that existing observational methods based on quantifying pre-defined criteria, or on valuable but variable clinical experience (‘clinical eye’), are not sufficient for screening or diagnosis of all relevant cases.

The aim of the current study was to use an inductive method for coding behavioural observations of child mealtimes to build on existing research (Hoffmann, 1992; Sanders et al, 1993, and Chatoor, Ganiban, Harrison and Hirsch, 2001) by identifying a range of mealtime characteristics for ARFID children that was unconstrained by prior beliefs or expectations. Furthermore, the objective was to identify how the feeding behaviours and characteristics of children with ARFID compare and contrast to those of typically developing children (i.e., which behaviours are comparable between groups, and which behaviours differentiate groups?), in the absence of overt physical indicators of disorder such as tube-feeding or significant growth faltering. It was believed that the inductive approach to coding would identify additional, subtle behavioural characteristics that differentiate children with ARFID from children without ARFID.

Method

Participants

Parents of children under the age of seven years were recruited into the current study. Parents of children in the typically developing (non-clinical) group (*n*=21) were recruited through nurseries and play groups. Families who were seeking or receiving healthcare, clinical input, or professional consultation for a child feeding issue were excluded from the non-clinical group. Participants were recruited into the clinical group (*n*=19) if their child had a diagnosis of ARFID. Diagnoses were confirmed by two paediatric psychologists, who saw the children separately, and used the DSM-V criteria for ARFID. Recordings of ARFID mealtimes were collected at the point of referral and prior to the first consultation with the clinical psychologist by a trained assistant psychologist, as part of the assessment procedure. Procedures for collecting and using video footage were explained to parents by the clinician (clinical group) or investigator (non-clinical), and parents were given the choice to participate. One parent in the clinical group withdrew from the study post data collection, leaving a final sample of *N*=39 children, ranging in age from 18 to 72 months (median=32 months; IQR=25-44). The non-clinical group included twelve girls (57%) and nine boys, with a median age of 32 months (IQR=25-38; range 18-72 months). The clinical group comprised 7 girls (38.9%) and 11 boys; median age 36 months (IQR=24.75-55; range 18-70 months). It was not possible to match children on a one-to-one basis; however, the two groups did not differ significantly in terms of age (U=216.5, p=0.44), gender ($\chi^2(1, 39)=1.3$, p=0.26), or meal duration (U=175, p=0.71), and these factors were controlled for in all analyses to avoid confounding due to any minor differences. Although average meal duration did not differ significantly between clinical and non-clinical groups (mean 20.1 vs. 19.3 minutes, respectively) and durations were approximately normally distributed in both groups, the spread of durations was notably greater for the clinical group (3.97 to 41.97 mins) than the non-clinical group (11.13 to 31.42 mins).

Procedure

Volunteers were contacted by the lead investigator to organise the video observation, and all observations were made in the child's home. Parents were informed that the video should feature a typical mealtime; it should be at the child's usual main mealtime (either midday or evening meal), with foods chosen by the parent/child as typical, and in the typical manner and context. On the day of the observation parents completed a consent form and a small number of demographic questions, then recording equipment was positioned according to advice from parents regarding the child's usual mealtime seating arrangement. When parents had fully prepared the child's meal the video camera was started and the researcher left for the entirety of the meal. The objective was to minimise disruption to the normal family mealtime and minimise the child's awareness of the recording equipment as much as possible. At the end of the meal, as determined and terminated by the parent, the researcher stopped the recording equipment. Parents were then debriefed and given an opportunity to ask questions of the researcher. Since it was essential that observations reflected typical events and behaviours (for that child and family, at that time), that were not altered by the observation process, parents were asked to confirm whether or not the mealtime was considered a 'typical' experience. No irregularities were reported and so all observations were taken forward for analysis.

Behaviour/action coding

In the current study, behaviours of interest were not predetermined as they have been in past observational studies (e.g., Sanders, 1993). Instead, an inductive approach was taken to observation coding. The aim of an inductive approach over more traditional deductive coding was to examine the full range of actions and behaviours that occurred during a child's mealtime, without preconception or predetermination about what was important (Thomas, 2006). The aim was to provide a rich body of data from which the mealtime characteristics of children with and without ARFID could be examined and contrasted. In the current study all physical actions or movements were coded and recorded using shorthand descriptions (e.g., 'lkf' - looks at food, 'enf' - engages with a non-food/non-mealtime item). This approach was designed to reduce the chance of observer selection or interpretation when recording actions.

An adapted coding approach was used in the current study, based upon Partial Interval Recording (PIR) (Cone & Foster, 1982; Harrop, Daniels & Foulkes, 1990; Klesges et al., 1983). PIR, which has been used by a number of other researchers in the field (e.g., Klesges et al., 1983; Stark et al., 2000), involves splitting observations into short intervals and reporting all observed behaviours during each interval. Typically, this method involves coding the presence or absence of predetermined behaviours of interest within each interval. Because criticisms concerning estimates of behaviour frequency have been levelled at PIR when larger intervals such as 30-60 seconds are used, or if multiple occurrences of the same behaviour happen within a single interval (Harrop et al., 1990), a five second interval was adopted in the current study. Furthermore, all behaviours occurring in each interval, including repetitions of the same action, were recorded.

Each interval was viewed multiple times to ensure accuracy and completeness of recording. Descriptors for all actions were entered into a coding matrix in a serial manner to allow examination of the distribution of actions across the duration of a meal, though certain actions could occur simultaneously (e.g., *looks at food*, *touches cutlery*, and *talk* could all occur at the same time). It was not possible for the primary investigator to be blinded when coding observations; however, two additional researchers, who were blind to group assignment, also coded observations to assess reliability among the actions recorded. The first double-coder coded all 39 videos, while the second coded a random subset of 15 (38%) videos. Second coders were instructed to record all observed actions and to avoid behaviour interpretation (e.g., intention beyond the physical action or function of the behaviour). It was found, when assessing double coding, that certain discrete actions were overlooked by individual double coders; however, ‘good’ (ICC 0.60 – 0.74) or, in the majority of cases, ‘excellent’ (ICC >0.75) reliability was evidenced (by two-way random effects ICC models for absolute agreement) between all of the actions coded by the primary coder and at least one other coder across the range of outcome scores included in the current paper (see table 1).

To avoid coding bias, no processing, sorting, or summarising of codes was undertaken until all mealtime observations had been fully coded. After coding, the number of unique codes was identified across observations, and the frequency of each code was ascertained and recorded for each observation. This approach permitted comprehensive comparison between children with and without ARFID, making it possible to assess where differences existed between groups, and whether such differences related to the type or frequency/rate of behaviours.

Codes and outcome scores

In total, 99 unique behaviour/action codes were recorded by the primary coder during video coding, which related to what the child was doing with their hands, face, and body, what the child was touching and engaging/interacting with, and where the child was looking throughout the meal. Of the 99 unique codes, 84 were observed in at least one non-clinical observation, and 98 were observed in at least 1 clinical video. The code that was unique to the non-clinical group (‘engages with someone else’ food’) was only observed in one video. Of the 15 codes that were unique to the clinical group, ‘avoids looking at food’ was observed in 8 observations, and ‘lean’ and ‘toy in mouth’ were observed in 3, but the remaining 12 codes were observed in ≤2 of the cases in that group. Overall, 23 codes were relatively uncommon and only observed in two or fewer mealtimes in either group.

During coding quantification and data entry it was evident that many individual codes presented only very subtle topographical differences in action, or the same actions labelled with different codes (e.g., lean and reach). This meant that some individual codes were recorded in very few observations, despite the fundamental action being common to most or all observations. Therefore, topographically similar behavioural codes were clustered to form practically and statistically more robust behavioural categories for analysis (e.g., cough, choke, sneeze - grouped under a ‘respiratory’ category). Codes observed for at least 50% of children in at least one group (53 codes) were identified; these codes were grouped together if appropriate, and other topographically similar codes from the total list were added where relevant. This process resulted in the pooling of approximately 80 codes into 30 outcome scores (presented in table 1), according to similarity of codes and nature of the action. Codes that were not taken forward for analysis were actions that were rare across all observations (e.g., puts rubbish in bin, snatch, and yawn), meaning that they were observed very few times and in very few observations. All scores except ‘refuse/avoid food’ were found to be reliable among raters; the 29 reliable scores were taken forward as behavioural outcomes (dependent variables) to be compared between the two study groups (independent variable).

Statistical analyses

For each of the 29 behaviour outcomes measured in the current study, the frequency (number) and rate (per minute) of occurrences were examined within clinical and non-clinical groups, and then compared between these groups. Behaviour frequency represented the total number of times that a particular action was observed within a total mealtime period for each child. In contrast, behaviour rate (calculated by dividing the total behaviour frequency by the meal duration in minutes for each child) represented the number of times an action or behaviour was observed per minute. Rates were calculated in order to take account of the variability in meal duration across the total sample, and to give an indication of behaviour incidence. For example, a rate ≥1 would represent a behaviour that occurs one or more times per minute; this could be considered a relatively high rate behaviour since it may occur multiple times in even very brief meals. In contrast, a rate <0.1 would represent a behaviour that occurs less than once in 10 minutes, which could be considered a low-rate or uncommon action, occurring only once or twice across an average meal duration.

Table 1

Categories and subcategories of actions observed during mealtime observations and their composite codes.

Category		Behaviour Outcome Score	Included Action Codes
All Eating/Intake	1	Bites	Bites of food
	2	Bites (fed by parent)	Bites fed by the parent
	3	Chewing	Chewing
	4	Drinks	Drink
	5	Licking	Lick food, lick cutlery, lick lips
All Engagement Food/Drink	6	Active Engagement Food/Drink	touching, moving, preparing food/drink
	7	Passive Engagement	Touching but no movement/attention
	8	Touch/Engage with Cutlery	Touch or use cutlery
Looking at Food Related	9	Looks at Cutlery	Look at cutlery
	10	Looks at Food	Look at food (own or others')
	11	Looks at Hands	Look at hands
	12	Looks at Others' Food	Look at someone else's food
Not Looking at Food	13	Not Looking at Food	Looking at parent or sibling, TV or other non-specified, look at hands, eyes closed, glance
All Small Movements	14	Sitting Movements	Lean, fidget, clap, arms up, move body away, reach, slouch, kneel, reposition, move, mess about, move body away, thumbs up, engage with something else
	15	Touch Head/Face	touch face, hands on head
	16	Wipe Hands/Face	wipe hands, wipe face
Standing Movements	17	Stand Movements	Stand, walk, run, dance, out of shot, escape
Laugh	18	Laugh	Laugh
Upset	19		

Behaviour rates and frequencies were compared between clinical and non-clinical groups using both ANOVA and ANCOVA models to compare unadjusted and adjusted mean differences. One-way univariate ANOVA was used to calculate unadjusted mean difference in the first instance; then, univariate ANCOVA was used to examine the same group differences (IV) whilst controlling for potential confounding variables. Child age (months), child sex (girl/boy), meal duration (minutes), and meal choice (midday or evening meal) were considered to have the potential to influence the types and rates of behaviours observed during a child's mealtime, and hence, confound the difference between clinical and non-clinical groups. Therefore, these variables were entered as covariates, to adjust for their influence in all ANCOVA models of behaviour frequency. The same confounders, with the exception of meal duration, were controlled for in all ANCOVA models of behaviour rate.

Examination of dependent variables revealed heterogeneity of variance in some of the behaviour frequencies and rates (both frequency and rate of bites, parent fed bites, looking at someone else's food, indications of upset, respiratory actions, engagement with non-food/mealtime items, and food expulsion, and, rate only of non-verbal communication). Despite these differences, sensitivity analyses comparing parametric and non-parametric ANOVA models, demonstrated very little change in the overall significance of group differences, and so appeared to be robust to these data issues. Similarly, residual statistics were found to be positively skewed in a number of models (both frequency and rate of standing movements, laughing, respiratory actions, giving mealtime items to parents, and losing/dropping food intentionally, and, rate only of drinks, passive engagement, wiping hands/face, and food expulsion). In all but two of these models (laughing and food expulsion rates, which were both low in number and positively skewed in both groups) square root transformation of the dependent variable normalised residuals. However, this had negligible influence on the significance of between-group differences, with p-values remaining the same or very similar in each case. Therefore, for ease of interpretation, results of all ANOVA and ANCOVA models (i.e., mean differences, confidence intervals) represent the raw data. Furthermore, for comparability with models, descriptive statistics are presented as means and standard deviations for both behaviour frequencies and rates. All analyses were carried out using SPSS for statistics v22; group differences were identified as statistically significant at $p<0.05$, with 95% confidence intervals used to further interpret group differences.

Results

Behaviour frequencies and rates

Across all behaviour outcomes only 'toy/object in mouth' was unique to one group (clinical); all others, including food refusal, were observed in both study groups to varying degrees. Because toy/object in mouth was not observed at all in the non-clinical group, it is not included in inferential statistical analyses. Group summaries for all behaviour frequencies and rates are presented in table 2.

As shown in table 2, there was relative similarity between groups for many of the observed behaviour outcomes, wherein the behaviour rates and frequencies, whether relatively high or low, were comparable for clinical and non-clinical observations. However, for 10 outcomes the rate of behaviour in one group was more than twice that of the other group. This discrepancy is of less practical significance for behaviours that occur at a low rate, such as food expulsion or respiratory outcomes; even at the highest rates, these actions occurred less than once every ten minutes. However, for higher rate behaviours, such disparity represents notable differences in the mealtime behaviour profiles of children with and without ARFID. Four behavioural outcomes demonstrated a large imbalance between groups despite occurring at relatively high rates in both groups. Child-led bites occurred at less than half the rate (rate ratio = 0.47) in the clinical group relative to the non-clinical group, whilst touching or engaging with cutlery (2.40), sitting movements (2.05), and engaging with non-food/non-mealtime items (2.38), showed more than twice the incidence in the clinical group compared to the non-clinical group. Three behaviours ('*looking at others' food'*, '*parent fed bites*', and '*upset*') were observed at relatively low rates in the non-clinical group (i.e., few times across an entire meal) but higher rates in the clinical group (i.e., every one to two minutes). ANOVA was used to further investigate the clinical significance of observed differences, with particular focus on higher rate behaviours in one or both groups.

Table 2

Descriptive statistics (means (standard deviation)) to summarise behaviour frequencies (number) and rates (per minute) for clinical (*n*=18) and non-clinical (*n*=21) observations, and the ratio of rates between groups (clinical/non-clinical)

	Clinical		Non-Clinical		
	Frequency	Rate/min	Frequency	Rate/min	Rate Ratio
Bites	40.89 (22.82)	2.32 (1.40)	96.19 (44.86)	4.98 (2.23)	0.47[a]
Parent Fed Bites	9.56 (14.01)	0.54 (0.94)	1.24 (2.34)	0.06 (0.10)	9.00[a]
Drinks	5.94 (11.95)	0.25 (0.36)	5.76 (7.61)	0.33 (0.50)	0.76
Chewing	120.56 (78.07)	6.61 (3.45)	178.62 (50.55)	9.19 (2.19)	0.72
Licking	16.06 (15.65)	0.87 (0.83)	9.19 (14.20)	0.48 (0.82)	1.81
Active Engagement F/D	70.94 (52.40)	3.84 (2.25)	134.43 (54.42)	6.97 (2.42)	0.55
Passive Engagement F/D	23.56 (33.04)	1.17 (1.46)	30.57 (29.08)	1.50 (1.34)	0.78
Touch/Engage with Cutlery	80.78 (61.34)	4.23 (2.98)	37.00 (47.26)	1.76 (2.18)	2.40[a]
Looking at Food	125.33 (83.58)	7.00 (4.10)	167.29 (66.93)	8.65 (2.86)	0.81
Looks at Others' Food	13.39 (24.06)	0.71 (1.24)	3.76 (7.16)	0.17 (0.29)	4.18[a]
Look at Cutlery	17.78 (22.05)	0.96 (1.19)	11.00 (20.02)	0.49 (0.80)	1.96
Look at Hands	7.83 (7.47)	0.39 (0.27)	5.62 (6.89)	0.29 (0.34)	1.34
Not Looking at Food	312.39 (154.29)	16.21 (4.25)	257.05 (96.03)	13.00 (3.81)	1.25
Sitting Movements	122.56 (81.68)	6.57 (2.95)	67.71 (72.35)	3.21 (2.64)	2.05[a]
Touch Head/Face	17.78 (11.68)	0.98 (0.61)	19.19 (22.22)	0.94 (0.97)	1.04
Wipe Hands/Face	10.33 (7.88)	0.54 (0.43)	13.43 (16.88)	0.63 (0.68)	0.86
Standing Movements	21.56 (41.05)	1.15 (1.73)	18.29 (41.80)	0.77 (1.40)	1.49

Laugh	2.33 (6.59)	0.08 (0.22)	1.14 (3.29)	0.06 (0.16)	1.33
Upset	7.61 (9.46)	0.47 (0.68)	0.90 (2.28)	0.04 (0.10)	11.75[a]
Talk	65.28 (58.04)	3.60 (2.64)	50.19 (35.13)	2.58 (1.69)	1.40
Non-Verbal Communication	9.22 (9.24)	0.48 (0.39)	2.86 (3.89)	0.15 (0.21)	3.20[a]
Respiratory	1.56 (3.24)	0.08 (0.16)	0.14 (0.65)	0.01 (0.03)	8.00[a]
Toy/Object in Mouth	2.78 (7.14)	0.14 (0.37)	0.00 (---)	0.00 (---)	---[b]
Engage w/Non-Food/Mealtime	47.61 (44.88)	2.36 (2.17)	19.43 (19.43)	0.99 (1.02)	2.38[a]
Disengage from Food/Meal	8.06 (8.47)	0.40 (0.35)	8.76 (9.42)	0.43 (0.41)	0.93
Give Meal Objects to Parent	3.00 (3.96)	0.16 (0.19)	3.05 (5.32)	0.17 (0.28)	0.94
Drop Food Intentionally	1.83 (3.31)	0.10 (0.17)	1.48 (3.03)	0.06 (0.13)	1.67
Lose Food Unintentionally	3.50 (3.29)	0.17 (0.16)	4.33 (4.37)	0.21 (0.20)	0.81
Food Expulsion	1.72 (3.34)	0.09 (0.18)	0.95 (1.83)	0.04 (0.09)	2.25[a]

[a]Behaviour rate in one group was more than twice that of the other group (i.e., rate ratio >2 or <0.5); [c]Rate is not compared between groups for ‘Toy/Object in Mouth’ due to zero variance in the non-clinical group.

Models of observed mealtime behaviours

A series of ANOVA models were used to compare clinical and non-clinical child mealtime behaviours for the 28 mealtime behaviour outcomes observed across both study groups. Unadjusted and adjusted mean differences in behaviour frequencies are presented in table 3; each adjusted (ANCOVA) model was controlled for child age and sex, meal duration, and meal choice (midday vs. evening meal). Unadjusted and adjusted mean differences in behaviour rate are presented in table 4; in this case, adjusted models were controlled for child age, sex, and meal choice.

Overall, models of behaviour frequency and rate were found to be highly comparable across all behaviour outcomes. The only exception was the model of touching/engaging with cutlery, which did not differ significantly between groups in frequency, but did in rate. Children in the non-clinical group were found to display significantly higher levels of behaviours that indicate direct and intentional interaction with food and the mealtime; these included the number and rate of bites eaten and the amount of chewing, as well as the amount of active physical engagement with food and looking at food. In contrast, children in the clinical group demonstrated significantly higher levels of behaviours that are suggestive of poor engagement and participation in feeding. This included significantly more parent feeding of bites, not looking at food, sitting movements, and engagement with other, non-food/mealtime objects. Clinical children also displayed significantly more indications of upset, non-verbal communication, and respiratory actions than non-clinical children but at far lower frequencies. In contrast to the bivariate indications in table 2, there were no significant differences between groups for food expulsion, looking at someone else's food, or frequency of touching and engaging with cutlery, once confounding influences were controlled for.

Table 3

Unadjusted (ANOVA) and adjusted[a] (ANCOVA) group differences (clinical – non-clinical) in behaviour frequencies for 28 observed child behaviour outcomes

	Unadjusted (ANOVA)		Adjusted[a] (ANCOVA)				
Behaviour Outcome	Mean Difference	*p*	Mean Difference	95% CI	F^	*p*	η_p^2
Bites[b]	-55.30	<0.01*	-57.04	-81.78, -32.29	22.00	<0.01*	0.40
Parent Fed Bites[b]	8.32	0.01	11.64	5.21, 18.07	13.56	<0.01	0.29
Drinks	0.18	0.95	0.59	-6.42, 7.60	0.03	0.87	<0.01
Chewing	-58.06	0.01	-59.10	-96.33, -21.87	10.43	<0.01	0.24
Licking	6.87	0.16	6.74	-4.28, 17.77	1.55	0.22	0.05
Active Engagement F/D	-63.48	<0.01	-71.50	-105.19, -37.81	18.65	<0.01*	0.36
Passive Engagement F/D	-7.02	0.49	-3.21	-24.72, 18.30	0.09	0.76	<0.01
Touch/Engage with Cutlery[b]	43.78	0.02	29.23	-6.42, 64.87	2.78	0.11	0.08
Looking at Food	-41.95	0.09	-61.87	-108.17, -15.57	7.39	0.01	0.18
Looks at Others' Food[b]	9.63	0.09	4.90	-6.96, 16.77	0.71	0.41	0.02
Look at Cutlery	6.78	0.32	4.59	-8.14, 17.32	0.54	0.47	0.02
Look at Hands	2.21	0.34	3.05	-1.80, 7.91	1.64	0.21	0.05
Not Looking at Food	55.34	0.18	60.50	7.03, 113.98	5.30	0.03	0.14
Sitting Movements[b]	54.84	0.03	59.70	12.50, 106.90	6.62	0.02	0.17

Touch Head/Face	-1.41	0.81	-1.54	-14.35, 11.27	0.06	0.81	<0.01
Wipe Hands/Face	-3.10	0.48	-3.89	-13.12, 5.34	0.74	0.40	0.02
Standing Movements	3.27	0.81	4.61	-24.76, 33.98	0.10	0.75	<0.01
Laugh	1.19	0.47	0.70	-2.99, 4.39	0.15	0.70	<0.01
Upset[b]	6.71	<0.01	5.05	0.37, 9.72	4.83	0.04	0.13
Talk	15.09	0.33	8.55	-22.45, 39.53	0.32	0.58	0.01
Non-Verbal Communication[b]	6.37	<0.01	4.88	0.63, 9.13	5.46	0.03	0.14
Respiratory[b]	1.41	0.06	1.77	0.19, 3.35	5.16	0.03	0.14
Engage w/Non-Food/Mealtime[b]	28.18	0.01	34.55	12.73, 56.37	10.38	<0.01	0.24
Disengage from Food/Meal	-0.71	0.81	-2.46	-8.19, 3.27	0.76	0.39	0.02
Give Meal Objects to Parent	-0.05	0.98	0.75	-2.62, 4.13	0.21	0.65	<0.01
Lose Food Intentionally	0.36	0.73	0.85	-1.43, 3.12	0.57	0.45	0.02
Lose Food Unintentionally	-0.83	0.51	-0.55	-3.24, 2.15	0.17	0.68	<0.01
Food Expulsion[b]	0.77	0.37	1.56	-0.31, 3.43	2.89	0.10	0.08

[a]Calculations of adjusted mean difference were controlled for child age and sex, meal duration, and meal choice (midday/evening); [b]Behaviour rate in one group was more than twice that of the other group (i.e., rate ratio >2 or <0.5); ^degrees of freedom for all ANCOVA main effects F ratios (1, 33); *p<0.001; η_p^2 partial eta squared (effect size).

Table 4

Unadjusted (ANOVA) and adjusted[a] (ANCOVA) group differences (clinical – non-clinical) in behaviour rates for 28 observed child behaviour outcomes

	Unadjusted (ANOVA)		Adjusted[a] (ANCOVA)				
Behaviour Outcome	Mean Difference	*p*	Mean Difference	95% CI	F^	*p*	η_p^2
Bites[b]	-2.66	<0.01*	-2.62	-3.95, -1.29	16.02	<0.01*	0.32
Parent Fed Bites[b]	0.48	0.03	0.69	0.26, 1.11	10.73	<0.01	0.24
Drinks	-0.08	0.59	-0.06	-0.39, 0.26	0.15	0.70	<0.01
Chewing	-2.58	<0.01	-2.21	-4.19, -0.23	5.14	0.03	0.13
Licking	0.38	0.16	0.42	-0.19, 1.02	1.97	0.17	0.06
Active Engagement F/D	-3.14	<0.01*	-3.39	-5.05, -1.73	17.27	<0.01*	0.34
Passive Engagement F/D	-0.33	0.47	-0.15	-1.16, 0.86	0.09	0.76	<0.01
Touch/Engage with Cutlery[b]	2.48	<0.01	1.92	0.13, 3.72	4.76	0.04	0.12
Looking at Food	-1.65	0.15	-2.52	-4.91, -0.13	4.58	0.04	0.12
Looks at Others' Food[b]	0.55	0.06	0.29	-0.30, 0.88	1.00	0.32	0.03
Look at Cutlery	0.48	0.15	0.38	-0.25, 1.01	1.52	0.23	0.04
Look at Hands	0.10	0.33	0.15	-0.07, 0.37	1.82	0.19	0.05
Not Looking at Food	3.21	0.02	3.87	1.04, 6.69	7.73	<0.01	0.19
Sitting Movements[b]	3.36	<0.01	3.63	1.60, 5.66	13.24	<0.01	0.28

Touch Head/Face	0.04	0.89	0.04	-0.56, 0.63	0.02	0.90	<0.01
Wipe Hands/Face	-0.09	0.62	-0.15	-0.57, 0.27	0.50	0.49	0.01
Standing Movements	0.38	0.46	0.30	-0.83, 1.44	0.30	0.59	<0.01
Laugh	0.03	0.65	0.01	-0.13, 0.16	0.04	0.84	<0.01
Upset[b]	0.43	<0.01	0.38	0.05, 0.71	5.34	0.03	0.14
Talk	1.02	0.15	0.68	-0.88, 2.24	0.79	0.38	0.02
Non-Verbal Communication[b]	0.33	<0.01	0.28	0.06, 0.49	6.47	0.02	0.16
Respiratory[b]	0.07	0.05	0.09	0.01, 0.17	5.52	0.03	0.14
Engage w/Non-Food/Mealtime[b]	1.37	0.01	1.65	0.47, 2.83	8.10	<0.01	0.19
Disengage from Food/Meal	-0.03	0.81	-0.11	-0.37, 0.16	0.63	0.43	0.02
Give Meal Objects to Parent	-0.00	0.98	0.04	-0.14, 0.21	0.19	0.67	<0.01
Lose Food Intentionally	0.03	0.50	0.06	-0.05, 0.17	1.20	0.28	0.03
Lose Food Unintentionally	-0.04	0.53	-0.03	-0.16, 0.11	0.14	0.71	<0.01
Food Expulsion[b]	0.05	0.26	0.09	-0.01, 0.18	3.64	0.07	0.10

[a]Calculations of adjusted mean difference were controlled for child age, sex, and meal choice (midday/evening); [b]Behaviour rate in one group was more than twice that of the other group (i.e., rate ratio >2 or <0.5); ^degrees of freedom for all ANOVA models (1, 34); *p<0.001; η_p^2 partial eta squared (effect size).

Discussion

The current study examines the mealtime behaviours of children with and without ARFID. The aim was to identify mealtime behaviours associated with ARFID, and to demonstrate how the mealtime characteristics of children with ARFID differ from typically developing children. Children in the non-clinical group were differentiated from the clinical group by significantly greater active and productive engagement with food. This was demonstrated by an increase in physical and visual engagement and a resulting increase in bites and chewing, relative to the clinical group. In direct contrast, children in the clinical group were differentiated from the non-clinical children by significantly greater engagement with non-food and non-mealtime items both physically and visually, a greater reliance on parents for productive bite taking, and a far greater incidence of small movements whilst seated during the mealtime. Clinical children also showed a significantly greater amount of non-verbal communication, and a great number of respiratory actions and signs of upset, though the effect sizes were smaller and underlying frequencies were much lower in these cases. Despite the relatively small samples included in the current study, the majority of models demonstrated definitively large (and significant) or small (and non-significant) differences between groups. The main exception to this was the outcome 'Touch/Engage with Cutlery', which showed a non-significant difference in frequency between groups, but a wide and highly imbalanced confidence interval, (which could suggest a lack of power to detect statistical significance).

The current study supports past research, which suggests that children with ARFID eat consistently fewer bites of food during their meal than children with no feeding disorder (Arvedson, 2008; Casey et al, 2009; Levy et al, 2009; Woods, 2010). Even when controlling for differences in meal duration observed across the whole sample, ARFID was a strong predictor of differences in the number and rate of bites attempted in the current study. Child-led bites and chewing were significantly lower in frequency and rate, while parent feeding of the child was significantly more common than in non-clinical children, irrespective of child age. Parent feeding may account for the elevated levels of non-verbal communication and upset observed in the clinical group; however, it is important to note that parent behaviour may be in response to escape-maintained behaviours used by the child over time. Therefore, causal conclusions concerning parent feeding and ARFID should be avoided. The increased non-verbal and distressed behaviours observed in this study support existing literature concerning associations between disordered feeding, emotionality, and negative mealtime behaviours (e.g., Arvedson, 2008; Benoit & Coolbear, 1998; Binnendyk & Lucyshyn, 2009; Burklow & Linscheid, 2004; Chatoor et al., 2001; Piazza et al., 2003). For some children, these responses may also communicate underlying skills deficits, and as such the function of specific actions and responses should be carefully considered (Aldridge, Dovey, Martin, & Meyer, 2010; Field et al., 2003). However, in the current study, these behaviours occurred at low frequencies even in clinical observations. Despite evidence of excessive fluid intake in some cases of ARFID, often as a method of food avoidance (Crist & Napier-Phillips, 2001; Smith & Lifshitz, 1994), frequency of drinks did not differ between groups in the current study. Rate of drinking was generally low for all children, but it was positively associated with meal duration.

The incidences of active engagement with food were considerably higher in the non-clinical group than the avoidant/restrictive group and this included looking at food as well as physical interactions. Conversely, passive engagement with food (touching but not looking at, moving, or manipulating food) did not differ. The inability of passive engagement to discriminate between groups may suggest that ‘avoidance’ in ARFID relates fundamentally to food intake rather than any contact with food or mealtimes. This inference is supported in the current study by the observation that the frequency of dynamic standing movements (i.e., standing, walking, leaving the mealtime environment) did not differ significantly between groups. The more widespread fear or avoidance of mealtimes and high rate of escape-maintained behaviours observed in some ARFID cases may reflect specific and identifiable aetiology (e.g., choking phobia, sensory sensitivity). Shifting attention away from food and onto other objects in the environment was observed at a significantly higher frequency in the clinical group compared to the non-clinical group. This finding reinforces existing literature, which suggests that avoidant/restrictive eating disorders may be associated with diminished appetite and motivation to eat (e.g., Berlin, Davies, Lobato & Silverman, 2009; Burklow & Linscheid, 2004; Byars et al., 2003; Ramsay, Gisel & Boutry, 1993; Rudolph, 1994). It suggests that non-clinical children possess a type/degree of motivation, which is much lower (or absent) in children with ARFID, to actively participate in mealtimes and to maintain interest and momentum in self-feeding. Whilst feeding literature highlights the importance of factors such as appetite regulation and socialisation (Birch, 1999; Stallberg-White & Pliner, 1999) in healthy dietary development, additional research is necessary to establish the nature of motivation in non-clinical children and the possible reasons for its decline in children with ARFID.

Lack of engagement is likely to be more subtle and more difficult to detect, interpret, or change than more overt responses such as food refusal or emotionality. Overt behavioural responses to food may cause parental concern, but these types of cues, on which parents gauge their own actions and responses, are fairly clear. In contrast, poor engagement may have a comparable negative impact on health, nutrition, and general mealtime success, but may be harder for parents to explain and/or demonstrate in a clinical setting, and thus they may be more anxiety provoking for parents. This supports the high levels of parental stress, anxiety, and deficits to parental self-efficacy observed in parents of children with problematic or disordered feeding (e.g., Feldman, 2004; Greer et al., 2008; Lindberg, Bohlin & Hagekull, 1994; Sanchez & Castillo-Duran, 2004). Such a situation may also lead parents to over-report the overt and more easily described behaviours in the clinical interview, reinforcing the over-reliance on these types of behaviours in clinical identification.

The final characteristic that was found to notably differ between groups was small movements that took place while the child was seated (i.e., repositioning, fidgeting, leaning, wiping face, putting hands on head, etc.). This category of movements was indicative of body movement, whereas specific actions relating to the child touching their hands, face, or head did not differ between groups. Meal duration was also highly associated with small seated movements, highlighting the fact that clinical and non-clinical children move around at mealtimes and particularly as meal duration is extended. However, the significant group difference in these fidgeting-type actions suggests that, in spite of the high prevalence across all children, those within the clinical group exceeded the rate of movement of their non-clinical peers. This supports existing research that associates significant feeding problems with factors such as poor motivation (e.g., Burklow & Linscheid, 2004; Rudolph, 1994), negative feeding associations (e.g., Chatoor & Ganiban, 2003; Field et al., 2003; Haas, 2010) and temperamental difficulty or regulatory problems (e.g., Berlin et al., 2009; Schmid, Schreier, Meyer & Wolke., 2010; Tauman et al., 2011), which suggest a failure to settle. These actions may also be associated with deficits in skills related to self-feeding, such as postural control or coordination (Arvedson, 2008; Redstone & West, 2004). The frequency and rate of these behaviours in the clinical group were more than twice that of the non-clinical group, suggesting that ARFID children are either generally more active at mealtimes than typically developing children, or instigation of these types of behaviours occurs much earlier in the meal. In either case, this supports research associating problematic feeding with hyperactivity and dysregulation (Aldridge, Dovey, Martin, & Meyer, 2016). Over-activity or particularly rapid instigation of restless movement may therefore offer an important signpost for the identification of clinically important feeding problems. In contrast to smaller-scale movements, the frequency of larger-scale standing or mobile movements (stand, walk, dance, etc.) was not found to differ between clinical and non-clinical groups. This is somewhat at odds with research that denotes ‘escape’ as a key characteristic of food avoidance in children with ARFID, and focuses on this behaviour as a central component in feeding interventions. While children’s reasons for leaving their seat or position at mealtimes may differ by group (further research would be necessary to examine this possibility), the current data suggests that the number of times this was done, did not.

It is important to acknowledge limitations of the current study sample; namely that the moderate sample size, coupled with a relatively broad range of ages (which we might expect to increase variability in the study outcomes), resulted in a reduction in analytical power. As a consequence, our conclusions regarding the precise size of differences that we might expect to observe between clinical and non-clinical populations are more restricted. In spite of these limitations however, clear and notable differences between groups, were demonstrated in the study, and supported by large effect sizes. It is also important to consider the number of comparisons made in the current study, and the potential for spurious significance as a consequence. Whilst many of the observed differences in behaviour outcomes in the study were statistically, as well as practically, definitive enough to withstand a more conservative alpha threshold, for others, statistical conclusions may have altered, depending on the chosen correction. Notably however, a medium or large effect sizes was observed in all such cases, suggesting that these outcomes may have practical importance in differentiating the study groups. Therefore, alpha was maintained at 0.05, but interpretation of all findings was made conservatively and within the context of additional statistical evidence (i.e., effects sizes and confidence intervals). The study has confirmed some existing features of mealtimes for children with significant feeding problems, and identified novel characteristics that clearly delineate typical and non-typical feeding in children. Furthermore, the results have shown that many of the behaviours thought to define disordered feeding actually feature in the meals of most children, but behaviour frequency differentiates those with disordered feeding from those without. A key finding of this study showed that children with feeding problems engage poorly with food and disengage more often, though this disengagement rarely featured emotionality or escape behaviours. Typically developing children are motivated to eat by intrinsic factors such as hunger, enjoyment and intrigue, and extrinsic sensory and social cues, but children in the clinical group appeared to lack the same motivation and desire, or perhaps skill, to engage with food/mealtimes, leading to parent-led strategies for increasing intake. This lack of engagement and readiness to disengage from food/feeding provides an explanation for many of the other factors that differentiate ARFID children from their non-clinical peers. This includes the reduction in the number of food bites attempted, and increases in fidgeting, restlessness, and signs of upset.

Recognition and support for medical conditions is linked to reduced anxiety and increased coping in parents (Garro, 2004; Graungaard & Skov, 2006), and the inverse may be liable for under-recognised parents of children who may be unobtrusively, but persistently, disengaged from mealtimes and feeding, and unmotivated to eat. This suggests an important mechanism behind problematic feeding behaviours and a potential opportunity for targeted intervention. It also offers a potential hypothesis behind the poor levels of identification and early 'intervention' for feeding problems. Based on the outcomes of the current study, the key message is that practitioners' observations of mealtimes and/or other clinical assessments of feeding (e.g., clinical interviews, standardised assessment tools) should give specific attention to the level of engagement and the general restlessness of the child during mealtimes, rather than focusing only on overt emotional rejection or escape-maintained behaviours. It is these subtle behaviours that are fundamental in identifying the child in need of clinical intervention during a typical mealtime. Focusing on the larger and much less frequent overt refusal behaviours during the assessment process is likely to lead to under-identification and late diagnosis of disordered children.

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