Fussy eating and feeding difficulties in infants and toddlers consuming a cows' milk exclusion diet

1   **Introduction**

2   Cows' Milk Allergy (CMA) is known to affect ~3% of children in the UK (1). It is also

3   known that parents may incorrectly perceive their child to have a food allergy (2) and

4   that allergen avoidance diets are sometimes initiated unnecessarily (3,4). In practice

5   this means that many children are excluding a major food group from their diet at a

6   time in life that is critical for growth, development and establishment of eating habits.

7   Infants with CMA who are not breastfed are prescribed hypoallergenic infant

8   formulae, which have an altered taste. Parents are also advised that their child

9   should follow a special weaning diet avoiding all forms of cows' milk, usually until at

10   least one year of age, but this exclusion diet may continue for much longer.

11   Fussy eating and feeding difficulties are separate entities, that may co exist.

12   Fussy eating, generally defined as "consuming a limited variety of food" is a very

13   common problem in young children (5). Up to 20% of infants and toddlers in the UK

14   are reported to be "problem" eaters by their parents (6) with some studies reporting

15   up to 50% are fussy eaters (7). In healthy infants and toddlers, it is known that

16   development of feeding skills occurs from 0-24 months with individual variation in

17   gaining self-feeding fine motor skills (8). Feeding difficulties refers to a spectrum of

18   problematic eating behaviours such as excessive spitting out of food, crying/irritability

19   at feeding time, eating extremely slowly, retching at the sight of bottle or spoon,

20   apparent difficulty in swallowing, throwing and pushing away food (Crist & Napier-

21   Phillips, 2001; Lewinsohn et al., 2005). Feeding difficulties are known to be more

22   common in certain medical conditions (e.g. autism spectrum disorder) (11).

23   In a young child with suspected or confirmed food allergy, where at least one

24   food group is already being restricted, fussy eating and feeding difficulties are likely

25   to have a considerable impact on eating habits and food intake. To date there has

26   been limited research directly investigating the prevalence of these eating problems

27   in children consuming a special diet for food allergy (12). The existing studies have

28 mainly recruited children with severe non-IgE mediated gastrointestinal disease and
29 have not included a control group of children eating a normal diet (13,14). The aim of
30 this study is to determine the prevalence of fussy eating and feeding difficulties in
31 infants and toddlers consuming a Cows' Milk Exclusion (CME) diet compared to a
32 control group consuming an unrestricted diet. If found to be more prevalent,
33 intervention by a qualified dietitian will ensure timely diagnoses and appropriate
34 advice to prevent long-term consequences of fussy eating habits.
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37 **Methods**
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39 **Study design**
40 This was a cross sectional study of 8-30 month old children from the Isle of Wight,
41 United Kingdom. This study included two groups: an experimental group, composed
42 of children consuming a CME diet for the treatment of presumed CMA and a control
43 group of children consuming an unrestricted diet. Children were eligible for inclusion
44 in the experimental group if they had consumed a hypoallergenic formula and/or a
45 CME diet in the first year of life for a period of 3 months or longer and or if they were
46 excluding other foods (e.g. egg or soya).
47 Recruitment took place between July 2013 and December 2014. Participants eligible
48 for the experimental group were identified via routine allergy clinics. The control
49 group was recruited from health visitor clinics in the same locality. Ethical approval
50 was obtained from Berkshire NHS ethics committee.
51
52 **Data collection**
53 Fussy eating and feeding difficulties were measured using two separate
54 questionnaires. Fussy eating was measured using the Picky Eater questionnaire
55 (15). It consists of 10 items describing specific behaviours related to fussy eating with
56 questions such as "overall to what extent does your child like a wide variety of foods
57 from those that you think he/she should eat?" and "how often do you prepare a
58 special food for your child because he/she does not like what the rest of the family is
59 eating?". Feeding difficulties was measured using the Montreal Children's Hospital
60 Feeding Difficulties questionnaire (16). It consists of 14 comprehensive questions,
61 covering the following feeding domains: oral motor, oral sensory, appetite, maternal
62 concerns about feeding, mealtime behaviours, maternal strategies used and family
63 reactions to child's feeding. Information was also collected on social demographics,
64 family history of allergy, allergic symptoms, infant feeding and growth.
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Data analysis

A power calculation for a two-tailed outcome, at 80% power indicated that 124 participants were required in this study. Questionnaires were scored and coded according to published guidelines. Data was analysed using SPSS software (IBM, version 20). Descriptive statistics were calculated. Differences between the CME and control groups were compared using Mann Whitney or X^2 test. Spearmann rho correlations were performed. Multiple regression calculations were performed to determine the contributing factors to the main outcome variables. A significance level of $p < 0.05$ was set for all analyses.

Results

Description of sample

126 participants were recruited. Demographic characteristics are detailed in Table 1. Participants in the CME group were younger than those in the control group ($p = 0.02$), but the age range was the same. There were no differences in gender, number of siblings, ethnicity, maternal age/education or growth measurements between the two groups.

Infant feeding and dietary exclusion

Details of participants' infant feeding history are shown in Table 2. The majority of infants had been breastfed at some stage (81%), but only 13.5% were being breastfed at the time of data collection. Infants in the control group were commenced on solid food ($p = 0.033$), lumpy food ($p = 0.049$) and finger foods ($p = 0.000$) significantly earlier than the CME group.

71.2% of the CME group was excluding cows' milk only, whilst 28.8% were excluding another food allergen in addition to cows' milk. Cows' milk was excluded at a median age of 9.5 weeks (range 1-30). Three infants in the CME group were breastfed as their main source of milk and did not have any substitute formula. At the time of data collection, the median duration of a hypoallergenic formula use was 41.0 weeks (range 2-91 weeks). The most commonly used hypoallergenic formula was Amino Acid Formula (45.5%), followed by Extensively Hydrolysed (EH) whey formula (25.8%) and EH casein formula (16.6%).

Reported symptoms and SPT status

Participants in the CME group reported a median number of 4.0 symptoms (ranging from 1-7 symptoms). Participants whose mother had a history of food allergy had

102 significantly more symptoms reported (p = 0.000), with reported higher rates of
103 vomiting (p = 0.037), abdominal pain (p = 0.000) and colic (p = 0.004) than those with
104 no maternal history of food allergy. Twenty participants (30.3%) in the CME group
105 had a positive SPT to cows' milk (> 3mm). Participants who had a positive SPT to
106 cows' milk reported significantly more symptoms (p = 0.006).

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108 **Main outcome measures**

109 **Feeding difficulties**

110 The median feeding difficulty score in the CME group (26.5, range 16-68) was
111 significantly higher than that of the control group (22.0, range 15-53) (p < 0.01),
112 although both groups were within the normal range (< 45). Nine participants in the
113 CME group (13.6%) had scores diagnostic of clinical feeding difficulties (> 45),
114 compared to only one participant in the control group (1.6%). There was no affect of
115 gender, being older or younger than 12 months, or breastfeeding status on feeding
116 difficulty score. Participants whose mothers had a history of food allergy symptoms
117 recorded significantly higher scores of feeding difficulties (p = 0.03).

118 Within the CME group, there was no correlation between feeding difficulty
119 score and age at introduction of hypoallergenic formula, duration or type of
120 hypoallergenic formula consumption or SPT status. However, some symptoms were
121 found to be significantly correlated with a higher feeding difficulty score. These are
122 listed in Table 3. In addition, the amount of milk substitute formula consumed per day
123 and "attention paid to healthy eating" were also found to be significantly correlated to
124 a higher feeding difficulty score as was a younger age at time of initiating the
125 exclusion diet. Maternal age, age of child, parental education, number of siblings,
126 duration of breastfeeding, age of introduction of solid/lumpy food and duration of
127 exclusion diet were not correlated with feeding difficulty score.

128 A standard entry multiple regression analysis was undertaken on the CME
129 group to determine the ability of several factors to predict the level of feeding
130 difficulties. In the final model, 41.3% of the variance in feeding difficulties could be
131 explained (R = 0.642, SE 11.09). A history of colic made the most contribution to this
132 model (B score = -0.459, p = 0.03). Three variables made a unique statistically
133 significant contribution (colic, dry cough at night and other food related problems).
134 Details are shown in Table 4.
135
136 **Fussy Eating**

137 The CME group had a significantly higher median score (22.5, range 10-63) than the
138 control group (18.0, range 10-44) (p < 0.01), indicating they have higher levels of
139 fussy eating, although both groups' median scores could be considered in the non-
140 fussy range(15). Overall there was no difference in scores for gender, being older or
141 younger than 12 months, maternal food allergy history or breastfeeding status. Within
142 the CME group, there was no correlation between fussy eating score and age at
143 introduction of hypoallergenic formula, duration of hypoallergenic formula
144 consumption, type of hypoallergenic formula or SPT status. A positive correlation
145 existed for volume of milk substitute consumed per day (Table 3).

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148 **Discussion**
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150 This study set out to compare level of feeding difficulties and fussy eating in two
151 groups of young children; one group consuming a CME diet for CMA and a control
152 group consuming an unrestricted diet. Overall we demonstrated that the CME group
153 scored significantly higher for fussy eating and feeding difficulties, although the
154 results for both groups were within normal ranges. Feeding difficulties were found to
155 be significantly positively correlated with a number of allergic symptoms and both
156 variables were found to be correlated with a higher volume of milk substitute
157 consumed per day.

158   The higher scores observed on the feeding difficulty questionnaire in the CME
159 group was statistically significant. This is the first time this has been reported in a
160 study of infants with suspected CMA using a control group and a validated
161 questionnaire. However it should not be overlooked that both groups had median
162 scores well within normal levels. Indeed the number of children in the control group
163 with feeding difficulties (1.6%) is considerably lower than that reported in previous
164 studies of normal healthy developing children (6,9), however the methodology for
165 those studies was different.

166   Studies of feeding difficulties and food allergy have typically been conducted
167 on children with complex gastrointestinal allergies (13,14,17), or in children who also
168 have an underlying comorbidity (18), therefore the participants are not necessarily
169 reflective of the "typical" infant with CMA. Meyer et al. (n = 437) found that 30-40% of
170 children with Food Protein-Induced Gastrointestinal Allergies (FPIGA) had feeding
171 difficulties reported in their medical notes, with a higher rate in those with symptoms
172 of abdominal pain, vomiting, bloating and constipation. Although there are
173 differences between that study and this; there are some commonalities. They

174 identified a significant correlation between feeding difficulties and extra-intestinal
175 manifestations (joint pain, lethargy, headaches). Likewise this study identified a
176 significant correlation between non-gastrointestinal allergic symptoms (wheeze and
177 cough) and feeding difficulty score, illustrating that childhood eating/feeding habits
178 are influenced by a wide range of health-related factors. It is known that oral eating
179 requires the coordination of a suck-swallow-breathe pattern and it may be that
180 difficulties in sensory processing are related to cardiorespiratory symptoms including
181 those present in asthma (19). Feeding difficulties are also reported in children with
182 other respiratory conditions (20,21).

183 Similar to the study by Crist et al (9), feeding difficulty score was not found to
184 be related to socioeconomic status or birth order/number of siblings. Contrary to
185 previous studies (22,23), a link between the age of introduction of any type of solid
186 foods and feeding difficulty score was not identified. Introduction of lumpy foods did
187 contribute to the multiple regression model predicting higher feeding difficulty score,
188 however only in combination with other variables. However, it must be highlighted
189 that the reporting of age of introduction of solid food was based on parent recall,
190 which may affect the accuracy of this data.

191 Overall infants in the CME group scored significantly higher on their fussy
192 eating questionnaire than the control group. However the median score of 22.5, is
193 still well below the maximum questionnaire score of 70, indicating that as a whole the
194 group were not particularly fussy eaters. In a previous study of 2-3 year old children,
195 "picky eaters" were found to have a mean score of 34.3, compared to "non-picky
196 eaters" who had a mean score of 22.7(15). A study of 12 month old infants
197 examining the role of food texture and fussiness reported a mean score of 25 on a
198 subscale of the questionnaire (24), which is similar to our findings.

199 No correlations were identified between fussy eating and allergic symptoms.
200 A recent study of 4 year old children in Holland identified a bidirectional correlation
201 between constipation and fussy eating (25). They found no difference in fussy eating
202 levels between those with and without CMA history (personal communication
203 Tharner, January 2015). Other studies have reported that fussy eating occurs across
204 different socioeconomic statuses, genders, ethnic groups and ages (15), which is
205 consistent with our findings. Across all participants, no difference in fussy eating
206 score was found in relation to maternal age or education/occupation status. It is
207 notable that the total volume of milk/milk substitute consumed/day was positively
208 correlated with fussy eating score. This supports the simple dietetic advice to reduce
209 excessive consumption of formula in order to encourage a better appetite and
210 mealtime behaviour.

211   Fussy eating can be difficult to quantify accurately and is usually evaluated by
212   a parental report tool or asking of a single yes/no question, rather than analysis of
213   dietary records (26). Although several tools have been developed for measurement
214   of preschool children's fussy eating behaviour, none have been specifically designed
215   for children under 18 months old and this was identified as a gap in the literature in a
216   recent review (27). The questionnaire used in this study was chosen as it has been
217   validated against behavioural measures of eating in 12-month old infants (24) and
218   against two types of dietary records in children aged 24-36 months old.

219   The measurement of feeding difficulties can also be problematic due to the
220   variability in definitions used. In many cases feeding difficulties are transient;
221   however it is not always straightforward to distinguish feeding problems that are likely
222   to be short-lived from those that are more persistent (28).   By comparison, the term
223   "Infant Feeding Disorder" is a formal diagnosis used in the current diagnostic
224   systems of the World Health Organisation ICD-10 [29] and Diagnostic and Statistical
225   Manual of Mental Disorders, 4th Edition (30). Both sets of criteria specify that an
226   infant feeding disorder is a persistent failure to eat adequately, associated with
227   weight loss/ significant failure to gain weight, that is not directly due to a medical
228   condition or another mental disorder, with onset before 6 years of age. As many
229   children who consume exclusion diets maintain a normal weight and have an
230   underlying disorder (i.e. food allergy), the use of this definition was not appropriate
231   for this study. Other classification systems such as the Chatoor criteria and Wolfson
232   criteria (31) have been developed, but both involve lengthy questionnaires. The
233   Montreal Hospital Children's feeding scale questionnaire is, to the authors'
234   knowledge, the only validated questionnaire for measurement of feeding difficulties in
235   children under two years of age (16). It is an easy to use measurement that has been
236   demonstrated to be valid and reliable in children with and without medical diagnoses
237   and could be quickly administered in an outpatient setting, in approximately five
238   minutes, with good reliability and internal consistency.

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240   **Limitations and strengths of study**

241   There are some limitations to this study. There may be a recruitment bias whereby
242   those more interested in diet are more likely to participate. The method used is
243   reliant on subjective parental report. Parental feeding behaviours, which have the
244   potential to influence infant feeding behaviours (32) were not assessed. The control
245   group was slightly older than CME group, which may have skewed the results
246   slightly. The CME group included participants consuming both single and multiple

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247 exclusion diets. As this was a typical caseload of patients from a secondary care
248 allergy clinic, participants were diagnosed with CMA using clinical history, SPT and
249 dietary exclusion/reintroduction, rather than an oral food challenge. As correlations
250 are reported, causality cannot be confirmed.

251   The strengths of this study are the use of a control group, which was recruited
252 from the same geographical locality as the CME group. The groups were closely
253 matched for all demographic variables; only participant age differed by three months.
254 As the research took place in a secondary care allergy clinic, the results are broadly
255 generalisable to the majority of other clinics around the UK. The fact that the infant
256 feeding data of the group as a whole is so similar to national feeding trends
257 demonstrates that the control group is also reflective of the general population. The
258 recruitment target of the study was met, meaning the study was sufficiently powered.
259 Validated and age-specific questionnaires were used. Data collection, coding,
260 analysis and interpretation took place by the same researcher to minimise the effect
261 of researcher bias.

262

263 **Conclusion**
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265 In summary, it has been demonstrated that infants consuming a CME diet for CMA
266 have significantly higher scores of feeding difficulties and fussy eating than a control
267 group consuming an unrestricted diet. This may be due to the underlying disease
268 process resulting in allergic symptoms, the restrictive nature of the CME diet or due
269 to feeding practices adapted by the parent and child. The number of allergic
270 symptoms was the factor that was most strongly correlated with feeding difficulties,
271 however type of symptoms was also important, as was the volume of milk substitute
272 consumed per day. However, it should be emphasised that the feeding difficulties
273 and fussy eating scores across the whole group were within normal ranges and there
274 was no effect seen on growth. This provides reassurance to health professionals who
275 assess and advise parents of children with food allergy.

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