

The role of complementary feeding methods on early eating behaviors and food neophobia in toddlers

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Running head: Eating behaviors and food neophobia in toddlers

Abstract

Background: Feeding methods used during infancy may impact upon eating behaviors in toddlers and influence the likelihood of developing weight issues. The aim of this study was to compare eating behaviors and food neophobia (defined as the reluctance to eat, or the avoidance of, new foods) in toddlers between three different complementary feeding (CF) groups; spoon-feeding (SF), baby-led weaning (BLW), and mixed method (MM). The study also aimed to investigate changes in early feeding practices and sociodemographic factors in relation to eating behaviors. **Methods:** One hundred and sixty-two parents with a child aged 12-48 months completed a questionnaire through online parenting forums and via Children's Centers. Parents reported their CF method at the point of introduction to complementary foods, the child's age when this occurred and the feeding method at one year along with breastfeeding duration. Toddler eating behaviors were measured using the Child Eating Behavior Questionnaire and the Child Food Neophobia Scale. The questionnaire also examined sociodemographic measures. **Results:** No significant differences were found in any measured eating behaviors or neophobia between CF groups. There were significant differences in breastfeeding duration, exclusive breastfeeding for 6 months, timing of CF, gestational age and weight at birth between CF groups. CF method changed at one year such that more people moved to a MM approach of feeding. **Conclusions:** CF method does not appear to influence toddler neophobia, and relationships between breastfeeding and BLW and later introduction of CF are further confirmed. Furthermore, it appears that individuals that do not undertake BLW at the onset of CF are rarely undertaking it at one year. This research implies that early CF methods do not influence eating habits during toddlerhood. Further work is required to educate parents on the benefits of progressing infants to complementary food by one year. *Keywords:* neophobia; baby-led weaning; spoon-feeding, breast feeding; complementary feeding; toddler

Introduction

Childhood obesity is a growing concern in the UK, with 9.3% of children in England aged between 4 and 5 years currently being classed as obese (Health and Social Care Information Centre [HSCIC], 2016). Due to the wide range of associated health problems, it is essential that the factors involved in developing obesity at a young age are identified so that weight issues can be prevented in early childhood. Eating habits in early childhood may be linked to weight status by influencing the likelihood of developing obesity (Gibbs et al., 2014).

Complementary feeding (CF) is defined as the transition from exclusive breastfeeding to family foods, a period which ranges from 6 to 18-24 months of infant age (World Health Organization [WHO], 2018). The WHO (2018) recommends that infants should start CF at 6 months of age. The WHO (2003) further advises that infants should be exclusively breastfed for the first 6 months of life, before being introduced to complementary foods alongside continued breastfeeding. The aim of CF is to move infants from consuming a single meal a day of soft finger food or pureed/mashed food at 6 months through to consuming three meals a day of chopped and family foods by one year (National Health Service [NHS], 2015). However, currently very little is known about how parents progress through from initial CF to CF at one year. During the introduction of complementary foods, parents may adopt different CF methods with their child. The traditional spoon-feeding (SF) method allows the parent to lead the feeding session, providing them with more control over what and how much food their infant eats using pureed foods. An alternative CF method used by parents is baby-led weaning (BLW), which encourages self-feeding such that the infant controls the feeding session and determines how fast they eat their meal and the foods they wish to consume (Rapley, 2015; Reeves, 2008).

Several factors appear to influence parents when choosing a CF method. For example, previous research has reported that mothers adopting BLW were more likely to have exclusively breastfed their infant and maintained doing so for a longer duration (Brown et al., 2011a). This relationship could be explained by socioeconomic factors, with studies reporting associations between higher socioeconomic status and both BLW (Brown et al., 2009) and longer breastfeeding duration (Brown et al., 2009). Interestingly, findings from Brown and Lee (2011a) show that returning to work is associated with being less likely to use BLW and that BLW was associated with more years of education and being married. This may indicate that those with less education or single parents may need to return to work sooner and hence choose a SF approach that is easier for caregivers. The corresponding use of BLW alongside breastfeeding has also been explained by the similar nature of BLW to breastfeeding. During breastfeeding the infant controls and regulates their intake of milk, meaning that a progression from breastfeeding to BLW may seem, to parents, to be the obvious choice as the infant will have control over their food consumption (Brown & Lee, 2011a).

Infant feeding practices and CF methods have previously been linked to early eating behaviors and preferences in toddlers in a number of studies (Brown & Lee, 2011a; Brown et al., 2013; Townsend et al., 2012). Birth weight has not been shown to influence choice of CF style (Brown et al., 2011b). However, it has been suggested that CF methods may influence the likelihood of developing childhood obesity, with SF infants showing a higher incidence of obesity compared with a larger proportion of underweight infants following BLW (Townsend & Pitchford, 2012) possibly due to BLW infants having more control over their food intake. Previous research has shown that satiety responsiveness (defined as the ability to regulate intake of food in relation to satiety) in children has been associated with Body Mass Index (BMI) scores, suggesting that certain behaviors may alter the risk of becoming overweight or developing obesity (Brown & Lee, 2013). Therefore, it may be the case that CF practices

influence eating behaviors, which subsequently may affect a child's risk of becoming overweight or obese.

In addition, the concept of fussy eating in toddlers has been explored in relation to the CF approaches adopted during infancy. One study reported that food fussiness (defined by picky and limited food choices) is significantly reduced in infants following a BLW approach compared with SF infants (Brown & Lee, 2013). This may be due to the introduction of a wider variety of family foods and foods with more texture earlier (Rapley, 2015).

Furthermore, this same study found that children who were exposed to BLW were less food-responsive (defined as the desire of the child to eat in response to food stimuli regardless of how hungry they are), and that children who had experienced SF during infancy were less satiety-responsive and were also significantly heavier (Brown & Lee, 2013). Thus, it appears that there may be a relationship between CF methods, early eating behaviors and body weight during childhood. One aspect of eating behavior in toddlers that has not yet been explored in relation to CF method is food neophobia, in which children reject and avoid novel or unknown foods (Dovey et al., 2008). Thus, further research is required to explore this novel area.

The current study

Aims

- i. The primary aim of this research was to determine whether CF methods used during infancy influence food neophobia and eating behaviors in toddlers. Research in this area is currently limited, and it still remains to be seen whether CF methods are associated with eating behaviors such as food neophobia.
- ii. This research also aimed to identify factors such as exclusively breastfeeding duration, infant age at onset of CF, maternal education and ethnicity, and infant weight, which may determine CF practices in early infancy (Brown & Lee, 2011a).

- iii. Finally, another purpose of this study was to look at whether parental practices change over time with regard to CF method at the onset of CF and at one year of child age.

Hypotheses

More specifically, we hypothesised that:

- i. There would be a change of CF method used at the onset of CF and at 1 year of infant age as infants become more independent by 12 months (Engle et al., 2000); indeed, we would expect SF infants to move towards self-feeding.
- ii. There would be a difference between CF methods regarding exclusively breastfeeding duration, infant age at onset of CF as well as weight at birth, maternal education, and marital status. Based on previous research (Brown & Lee, 2011a; Costantini et al., 2018; Townsend & Pitchford, 2012) we would expect mothers who follow the BLW approach to exclusive breastfeed their infant for a longer period of time. We would also expect BLW infants to be introduced at a later age in comparison to SF infants and we would expect BLW mothers to describe themselves well-educated and married.
- iii. There would be an effect of CF methods on food neophobia and eating behaviors; such that infants using BLW would have less food neophobia and would be less fussy (Brown & Lee, 2013).

We also explored the following variables, which may influence CF methods: maternal age, BMI, ethnicity, infant birth order and gender, and infant gestational age at birth. However, due to the lack of available literature on these topics, we made no hypotheses.

Methods

Participants

Approval for this study was granted by the XXXX University Departmental Research Ethics Officer in line with the Declaration of Helsinki. Parents with a child aged between 12 and 48 months were asked to complete a questionnaire examining CF methods, sociodemographic

variables and eating behaviors in toddlers. Exclusion criteria included parents under the age of 18 years old, and children with developmental difficulties.

Participants were initially recruited through an advertisement on message boards and related threads on online parenting forums (i.e. www.mumsnet.com; www.bounty.com; www.netmums.com). Participants followed a link via a web-based software tool: Qualtrics (Utah, USA, 2002). However, due to an insufficient response rate after 1 month; additional participants were recruited via the 51 Sure Start Children's Centres within a 20-mile radius of Oxford Brookes University. The Centre leaders were contacted via email and telephone, and questionnaires were sent along with stamped addressed envelopes, invitation letters and participant information sheets to those interested in participating in the study. The Centre leaders distributed the questionnaires and envelopes to Centre members to complete voluntarily. Questionnaires and signed approval forms from the Centre leaders were returned in sealed envelopes and posted to the researcher. In total, 25 questionnaires were returned via post and 191 participants responded online. However, 54 of the online respondents were excluded due to incomplete data or children with severe developmental difficulties, leaving 162 responses included in the analysis in total. The current study aimed to achieve a minimum sample size of 120 based on previous research using the Child Food Neophobia Scale, CFNS (Cooke et al., 2006; Park et al., 2016) and data collection was considered complete at this point.

The questionnaire included a participant information sheet to explain the research and provide researcher contact details, should the participants need further information. The information sheet instructed participants to contact their general practitioner if they had any concerns. It also clearly stated that completion and submission of the questionnaire would indicate consent to taking part in the study.

Measures

The questionnaire

Parents were asked questions about their child's age, gender, birth weight and current weight. They were also asked about duration and exclusivity of breastfeeding for 6 months. The onset of CF was determined by asking the age at which complementary foods were introduced. Sociodemographic measures included caregivers' age, height and weight, ethnicity, education, employment and marital status.

Parents reported their CF method by estimating the extent to which SF was used as a percentage of time spent feeding, and the extent to which finger foods were used as a proportion of all foods given to the child at the start of CF and also at one year. These provided a measure of the degree of BLW and SF used by parents, with response options including 0%, 10%, 25%, 50%, 75%, 90% and 100% (Brown & Lee, 2011a). Parents were classified as following BLW at the start of CF if they reported using SF 10% of the time or less and also reported their infant using finger foods 90% of the time or more. Parents were classed as following SF at the start of CF if they reported using SF 90% of the time or more and also reported using finger foods 10% of the time or less. Both criteria needed to be fulfilled to be classified into the BLW or SF group. All other responses were classed into a mixed method (MM) CF group. Parents were also asked about how much they used SF and finger foods when their child was one year old.

In addition, parents were asked questions regarding their child's eating behaviours, using the Child Eating Behavior Questionnaire (CEBQ) and the Child Food Neophobia Scale (CFNS), which were included in the on-line questionnaire. The researchers who developed these questionnaires were contacted and approval was gained for use of the questionnaires in this study.

Child Eating Behavior Questionnaire (CEBQ)

The CEBQ (Wardle et al., 2001) is a thirty-five-item parent-report questionnaire which assesses child eating methods related to obesity risk, using five point Likert scale (from 1 = never to 5 = always). Internal reliability (Cronbach's α) for the Child eating behaviour questionnaire ranged from 0.74 to 0.91 for each of the measures of eating behaviour. This was completed in children aged 2-4 years (Carnell et al., 2007; Wardle et al., 2001) and has been extensively used in research on child eating habits (Carnell et al., 2008; Viana et al., 2008; Webber et al., 2009). The CEBQ consists of eight sub-scales: Food responsiveness (FR; 5 questions; Cronbach's $\alpha = 0.76$), Enjoyment of food (EF; 4 questions; Cronbach's $\alpha = 0.90$), Emotional over-eating (EO; 4 questions; Cronbach's $\alpha = 0.70$), Desire to drink (DD; 3 questions; Cronbach's $\alpha = 0.87$), Satiety responsiveness (SR; 5 questions; Cronbach's $\alpha = 0.75$), Slowness in eating (SE; 4 questions; Cronbach's $\alpha = 0.68$), Emotional under-eating (EU; 4 questions; Cronbach's $\alpha = 0.77$), and Fussiness (FU; 6 questions; Cronbach's $\alpha = 0.93$). A score is obtained for each of the eight sub-scales (Wardle et al., 2001). Example questions include “My child eats more when worried” (EO), “My child eats more and more slowly during the course of a meal” (SE).

Child Food Neophobia Scale (CFNS)

The CFNS (Pliner, 1994) is a ten-item self-report questionnaire completed by parents, which measures food neophobia in children using seven point Likert scale (from 1 = strongly disagree to 7 = strongly agree). A final score is then obtained from the questionnaire. The CFNS has shown high internal consistency in previous research (Cronbach's α ranged from 0.83 to 0.92 (Pliner, 1994) and in the current study (Cronbach's $\alpha = 0.94$). It was originally designed in 5, 8 and 11 year olds but has been widely used in previous research on children neophobia in 2 year olds (Cassells et al., 2014; Howard et al., 2012). Example

questions include “My child is constantly sampling new and different foods” and “My child is very particular about the foods s/he will eat”

Data strategy and analysis

All data was tested for normality and were normally distributed. With regard to hypothesis (i), a chi square test was conducted to look at differences between CF methods used at the onset of CF and at 1 year of infant age.

With regard to hypothesis (ii), one-way ANOVAs with Bonferroni correction were carried out to examine differences between CF groups (i.e. BLW, MM, SF) on the following variables: exclusive breastfeeding duration, infant age and weight at the onset of CF as well as at birth. Chi square tests were used to look at differences between CF methods with maternal education and marital status as non-continuous measures.

With regard to hypothesis (iii), one-way ANOVAs with Bonferroni correction were conducted to examine differences between CF feeding groups on CFNS whole score and CEBQ sub-scales scores.

In order to investigate further variables, such as maternal ethnicity and employment status, infant gender and birth order as well as exclusive breastfeeding for 6 months, chi square tests were used. To test differences between CF groups on mothers’ age and BMI, one-way ANOVAs were carried out. The data were analysed using Statistical Package for the Social Sciences (SPSS, v. 23, USA, 2015).

Results

CF methods: changes over time

At the onset of CF, 26% of the mothers followed the BLW method, whereas 25% of the mothers followed the SF method. Forty-nine % of the mothers were further classified as

using a MM approach, which included both spoon-feeding and infant self-feeding. However, at 1 year of infant age, some of the mothers changed their CF method ($X^2(4, N = 162) = 66.49, p < .001$); indeed, only 2% of the mothers spoon-fed their infant, whereas 65% of mothers adopted a MM approach, and 33% followed the BLW method.

CF methods: breastfeeding, maternal and infant characteristics

With regard to exclusive breastfeeding and overall duration of breastfeeding, it was found that there were differences between the three CF groups, with all BLW mothers exclusively breastfeeding their infant for 6 months. In addition, the results indicated a significant effect of CF method on duration of breastfeeding such that BLW infants were exclusively breastfed longer in comparison to MM infants ($p < .001$) and SF infants ($p < .001$).

No maternal differences were found between the three CF groups (BLW, MM, SF₁) with regard to age, education, ethnicity, marital and employment status, or BMI (Table 1).

TABLE 1 ABOUT HERE

In contrast, several differences were found between the three CF groups regarding infant characteristics. As shown in Table 1, infant age at the onset of CF differed depending on the CF method; post hoc tests revealed that SF infants were introduced to complementary foods at a younger age than BLW ($p = .02$). There was also a significant difference in infant gestational age, with BLW infants being born at a later age than SF infants ($p = .003$). Infant weight at birth further differed between CF groups, with MM infants being lighter than BLW infants ($p = .02$), and although only approaching significance ($p = .08$), post hoc tests also revealed that SF infants had a lower birth weight than BLW infants.

¹ The groups were classified according to the feeding method adopted by mothers at the onset of CF.

CF methods: child eating behaviors and neophobia

No significant differences were found between the three CF feeding groups on the CEBQ Questionnaire sub-scales scores, and on the CFNS Food neophobia final score (Table 2).

TABLE 2 ABOUT HERE

Discussion

The first aim of the current study was to examine the changes in CF methods between the onset of CF and one year. At the onset of CF 26% of the mothers followed the BLW method, 25% of the mothers followed the SF method and 49% of the mothers were further classified as using a MM approach. However, by 1 year of infant age, only 2% were following the SF method with their infants, indicating that 23% had moved on to either MM or BLW. This is not surprising as it would be expected that an infant would gradually move onto more complementary foods and self-feeding as they get older and more competent at feeding themselves. However, only 33% of parents were BLW at 1 year, indicating only a 7% increase in BLW between the onset of CF and 1 year. This may indicate that those who were not using BLW as a method of feeding at the introduction of CF perhaps still did not feel confident in pursuing it as a method of feeding for their child even at one year. Recent research has identified that mothers who adopted a BLW approach scored significantly lower on restrained eating (Dutch Eating Behavior Questionnaire, DEBQ), anxiety and introversion (Ten Item Personality Questionnaire, TIPQ) and anxiety and obsessive-compulsive symptoms (Brief Symptom Inventory, BSI) (Brown, 2016) indicating that other mothers may feel more anxious about undertaking BLW and feel they have less control over the CF process.

Previous research has outlined a number of concerns regarding the use of BLW. Primarily

related to risk of choking with finger foods and inadequate nutrient intake (Cameron et al., 2012), which may indicate why parents in this study were slow to encourage their infants to primarily self-feed.

It has been identified that the majority of parents do not follow the WHO guidelines of introducing complementary foods at six months (Cameron et al., 2012). In this sample, the mean age of introduction to complementary foods varied between 5.31 months (SF group) to 5.92 (BLW group). Although this statistic closely matches the recommended age, it is important to note that the minimum age of introduction was 3 months and the maximum age was 12 months in this sample. Therefore, it is clear that some parents are not achieving the recommended guidelines. The findings of the current study demonstrate that the age of introduction to complementary foods was significantly higher in the BLW group than the MM and SF groups. These results are in line with earlier studies that report later onset of CF in those following BLW (Brown & Lee, 2011a; Brown & Lee, 2013). Previous research has identified that a BLW approach strongly predicts the introduction of complementary foods at the recommended age (Moore et al., 2014). One explanation for this association could be that the nature of BLW requires the infant to be developmentally ready in order to self-feed, as they must be able to sit up and hold their head steady with efficient hand-eye coordination (Brown & Lee, 2011a). Younger infants below the recommended age of 6 months for CF may not have met these developmental milestones, and thus may struggle to self-feed with complementary foods.

Following on from previous research (Brown & Lee, 2011a; Brown & Lee, 2013; Townsend & Pitchford, 2012), the second novel aim of this study was the first to explore new relationships between food neophobia and CF in toddlers. This research did not identify any trends or differences between CF methods in terms of food neophobia scores, suggesting that the two factors may be unrelated. Brown and Lee (2013) similarly examined food

responsiveness, satiety responsiveness, food fussiness and enjoyment of food. They reported that those infants who had followed BLW were reported to be significantly less food-responsive, less fussy, and significantly more satiety-responsive than those following SF methods, however once maternal control was accounted for, this relationship disappeared, and weaning style did not remain predictive of fussiness. This may indicate that BLW approach in itself is not associated with a wider acceptance of foods, but that it may be explained by the low level of maternal control involved in the method and this has been demonstrated in older children (Fisher et al., 2002). Unfortunately, maternal control was not measured in the current study.

It should also be noted however that the definition of BLW and SF was slightly different in the current study compared to the Brown and Lee's (2013) one; indeed, mothers were classed as BLW if they reported using both SF and purées 10% of the time or less. Alternatively, if mothers reported using both feeding their child and purées more than 10% of the time they were classified as SF. However, in the current study, the decision was taken to define the SF group in the same way as BLW group such that both groups needed to feed using their preferred method 90% of the time and use the opposite method of feeding less than 10% of the time. The remaining individuals were defined as being an intermediate mixed method group. This decision was taken to reflect NHS (2015) guidance that parents should use a combination of finger food and spoon feeding and to represent this group accordingly (NHS, 2015) and we believe this is a valuable addition to the literature. In contrast to the Brown and Lee's (2013) study, Townsend et al. (2012) found no differences in picky eating between those introduced to CF using BLW and those using SF, though this was measured using a simple yes/no answer and it is not clear how BLW and SF were defined.

Another finding of the current study was that there were no significant differences in body weight between the three CF methods. It has been implicated that that satiety responsiveness

in children has been associated with BMI scores and CF method with greater satiety responsiveness linked to lower BMI and BLW; this suggests that certain behaviors may alter the risk of becoming overweight or developing obesity (Brown & Lee, 2013), however in the current cohort this was not the case.

The results from this study demonstrate that breastfeeding duration was significantly longer in the BLW group than the MM and SF groups. This finding is consistent with previous research that has reported an increased likelihood of BLW mothers having breastfed and for a longer duration of time (Brown & Lee, 2011a). One possible explanation for this finding could be that mothers have allowed their infant to determine milk intake through breastfeeding, and therefore are more likely to adopt a BLW approach which uses the same principles as the infant controls their food consumption (Brown & Lee, 2011a). It has been suggested that the baby-led nature of breastfeeding is associated with a decreased risk of developing weight issues, as the infant learns to regulate their appetite and control their food intake (Brown et al., 2012). Thus, mothers choosing to breastfeed may be naturally drawn to a BLW approach with the aim of reducing their child's risk of becoming overweight or obese. It can also be noted from the data that the BLW parents were less likely to be employed full time, though this did not reach significance. It is known that full time employment is one of the barriers to continuing breastfeeding (Hawkins et al., 2007), hence the other groups may have stopped breastfeeding due to work related commitments.

The results of this study should be considered in light of the limitations. One of the main criticisms could be that the sample consisted of highly educated, predominantly white participants. The study was also cross sectional in nature and these factors reduce the generalizability of the results and mean that no inferences can be made about causality. The majority of participants were recruited online via websites, meaning that particular groups of people with internet access were indirectly targeted. People with access to the internet tend to

have a higher level of education (Brown & Lee, 2011a), which seemed to be the case in this study. The division of groups in this study was based on the parent's ability to recall how they introduced CF at approximately 6 months of age. However, the method of recalling information has been used in previous studies (Brown & Lee, 2011a; Costantini et al., 2018) to gather data on parental feeding practices; it is important to highlight that no methodological issues have emerged from these studies. In addition, as CF is considered to be a key milestone in child development, the information regarding CF practices and decisions, as part of parental experiences and responsibilities, is stored in the memory of a parent (Fivush, 2011). Finally the questionnaires used in this study have been more widely used in slightly older infants (2 years old) which may affect the application of the results.

Conclusion

This study suggests that CF method did not influence eating behaviors and neophobia in toddlers in this sample. However, previous research on this topic is mixed, and some eating behaviors have been linked to the CF method used during infancy. This study found that many of those who began CF with SF had moved on to some finger food by 1 year but not as many had progressed to BLW indicating that there may be some fear about infants solely relying on self-feeding even at one year and there may be a knowledge gap in relation to the benefits of using finger foods. This indicates that further advice and information on the benefits of CF progressing from puree to solids from 6-12 months is needed for some mothers.

Furthermore, this study confirmed that a longer breastfeeding duration and later time of introduction to complementary foods may be associated with BLW. Although this study did not find any differences in eating behaviors and neophobia it was conducted in a primarily white, British, educated population and future research should also study a range of ethnic groups and participants with varying levels of education in order to provide a more

generalizable sample. In conclusion, it may be the case that early feeding methods do not influence eating habits during childhood, and therefore perhaps do not play a role in the risk of developing weight issues. However further research is required into the nutritional content of the foods used in CF methods to confirm this further.

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