

TITLE PAGE

**Relationships between feeding practices and children's fussiness with vegetables**

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Short running title: Fussiness with vegetables

Word count abstract: 249; Main text: 5217. Number of references: 39; tables: 3

**Source of funding:** This research was funded by a PhD studentship provided by Loughborough University, UK.

**Conflict of interest:** The authors have no conflict of interest to declare

**Contributor statement:** CH contributed to the data collection, design, analysis and write up of this paper; EH and CF supervised CH and contributed to the design, analysis and write up of the manuscript.

## Abstract

Vegetables are commonly rejected by children, making it is important to consider factors which are associated with children's fussiness with vegetables. The current study aimed to investigate whether fussiness with vegetables is associated with a number of factors including: caregiver and child vegetable consumption; caregivers' general feeding practices; and caregivers' vegetable-specific feeding practices. Caregivers (N=297) of preschool children completed questionnaire measures of their child's fussiness with vegetables, as well as several caregiver and child factors hypothesised to be associated with children's fussiness with vegetables. Findings indicate that children who are fussier with vegetables consume a smaller quantity of vegetables and almost all have caregivers who eat a smaller quantity of vegetables. Children's fussiness with vegetables was not significantly related to any general feeding practices used by caregivers. However, children's fussiness with vegetables was significantly associated with use of several vegetable specific feeding practices. Caregivers of fussier children used more encouragement/pressure to eat with vegetables ( $r=0.14$ ,  $p=0.01$ ), hid vegetables within other foods more often ( $r=0.30$ ,  $p<0.01$ ), used more food rewards ( $r=0.19$ ,  $p<0.01$ ) and other rewards to encourage consumption of vegetables ( $r=0.21$ ,  $p<0.01$ ), and compromised more when feeding vegetables ( $r=0.14$ ,  $p=0.01$ ). These findings suggest that rather than caregivers' general feeding practices being related to children's fussiness with vegetables, caregivers' specific feeding practices used when vegetables are rejected are more significant. This study highlights that provision of information for caregivers on methods to avoid when faced with a child who is fussy with vegetables could be important for promoting children's healthy diet.

**Keywords:** Child, vegetable, fussiness, eating, feeding, parent

## Relationships between feeding practices and children's fussiness with vegetables

### Introduction

Vegetable consumption is associated with a reduced risk of many non-communicable diseases, such as cancer and obesity (e.g., Cox, Whichelow, & Prevost, 2007; Lennox, Olson, & Gay, 2011). However, vegetables are not only poorly liked by many children (Cooke & Wardle, 2005), but also significantly under-consumed (Public Health England & Food Standards Agency, 2014). Research suggests that while some feeding practices (such as modelling healthy eating) are successful for achieving healthy eating behaviour and food choice in children (e.g., Cullen, 2001; Hendy & Raudenbush, 2000), other feeding practices appear to be detrimental and can reduce children's consumption of the target foods (e.g., pressure to eat and restriction; Vereecken, Rovner, & Maes, 2010). A number of previous studies have investigated the general feeding practices which caregivers employ with their children (e.g., Blissett & Farrow, 2007; Gregory, Paxton, & Brozovic, 2010; Haycraft & Blissett, 2008; Musher-Eizenman & Holub, 2007). However, there is a lack of research concerning the feeding practices which caregivers employ specifically in relation to encouraging children to eat vegetables. It is possible that caregivers alter their feeding practices when faced with foods which are refused by children. With vegetables being crucial for health but commonly refused (Cashdan, 1998), exploring the relationships between the practices which caregivers use to feed their children vegetables and children's eating behaviours with vegetables is likely to be beneficial for the subsequent development of public health programmes aimed at promoting children's vegetable intake.

In order for children to like and accept rejected foods they need to be tasted a large number of times (e.g., Birch, Gunder, Grimm-Thomas, & Laing, 1998; Birch & Marlin, 1982; Sullivan & Birch, 1990). Therefore, it is crucial that vegetables are *reoffered* numerous times, as reoffering can be considered the key to achieving consumption of vegetables in children. Given the value of reoffering vegetables, we need to better understand caregivers' reoffering behaviours. Caregivers might use certain feeding practices to reoffer vegetables to children. For instance, caregivers may choose to hide vegetables

within other foods in order to promote consumption. Previous research suggests that hiding vegetables can increase children's consumption of vegetables (e.g., Spill, Birch, Roe, & Rolls, 2011), although this may not translate into vegetable consumption when they are subsequently not hidden (Pescud & Pettigrew, 2014). Caregivers may also choose to involve their child in meal preparation or choice in order to promote vegetable consumption. Previous research supports the use of such practices, where allowing children to choose from healthy foods is associated with higher vegetable consumption (Patrick, Nicklas, Hughes, & Morales, 2005). Conversely, controlling feeding practices, such as threats, may also be used by caregivers to encourage vegetable consumption, although more controlling practices tend to be associated with lower consumption (Patrick et al., 2005).

While some eating behaviours, such as enjoyment of food, have been positively related to vegetable consumption in pre-schoolers (Cooke et al., 2004), being generally more fussy about food has consistently been associated with lower consumption of vegetables (e.g., Galloway, Fiorito, Lee, & Birch, 2005). Furthermore, food fussiness seems to be associated with other eating behaviours. Children who are fussier show lower enjoyment of food and are less responsive to food (Svensson et al., 2011; Wardle, Guthrie, Sanderson, & Rapoport, 2001), demonstrating that food fussiness may exert a considerable influence over children's diet and eating behaviour. Moreover, children's fussiness with vegetables may be related to their caregivers' consumption of vegetables, with previous research indicating that children's vegetable consumption is positively related to caregivers' consumption (Cooke et al., 2004; Palfreyman, Haycraft, & Meyer, 2014). Exploring whether children's fussiness specifically with vegetables is associated with their other, general eating behaviours is important for determining potentially modifiable factors to target in future interventions. If this is found to be the case, it could indicate that broad spectrum interventions tackling general eating behaviours may be a worthwhile avenue for future research.

Caregivers' general feeding practices have also been associated with children's food fussiness, with caregivers using more pressure to eat with children who are generally fussier eaters (Gregory, Paxton, & Brozovic, 2011; Webber, Hill, & Wardle, 2010) and using higher levels of pressure with fussier siblings than their less fussy counterparts (Farrow, Galloway, & Fraser, 2009). However, what remains unknown is whether children's responses towards eating vegetables are associated with the feeding practices that caregivers specifically use when offering vegetables. Mothers of fussy children have reported that they are less likely to make healthy food readily available for their children (Tan & Holub, 2012). Furthermore, parents have been shown to use more ineffective feeding practices, such as restriction and force feeding, when their children have unhealthy food preferences (Russell, Worsley, & Campbell, 2015). Conversely, parents of children with healthy diets have been found to use more encouragement and involvement around healthy eating, and to be less indulgent about providing alternative foods (Russell et al., 2015). Together, this research suggests that caregivers may alter their general feeding practices according to their child's eating behaviour or food preferences. However, what has not been explored is which methods of offering caregivers use specifically when attempting to encourage consumption of rejected foods, such as vegetables.

In summary, children's general fussiness with food has been related to the feeding practices caregivers employ as well as children's general eating behaviours. However, whether children's fussiness specifically with vegetables is related to the feeding practices their caregivers use (in general or with vegetables) or to children's general eating behaviours remains unclear. It seems probable that caregivers may use different feeding practices, or use some feeding practices more frequently, with foods that are commonly rejected, in an effort to increase consumption. Therefore, this study aimed to investigate whether children's fussiness with vegetables is related to: (1) caregiver and child vegetable consumption, (2) caregivers' reoffering of vegetables, (3) caregivers' general feeding practices, (4) caregivers' vegetable-specific feeding practices, and (5) children's other eating behaviours. It was hypothesised that children who are perceived as fussier with vegetables would

have caregivers who consume a smaller quantity of vegetables and consume a smaller quantity of vegetables themselves than children who are less fussy. It was also hypothesised that children who are fussier would be reoffered rejected vegetables fewer times. It was further hypothesised that caregivers of children who are fussier children with vegetables would use more controlling feeding practices, and use specific vegetable feeding practices such as hiding vegetables within other foods, more frequently than caregivers of less fussy children. Lastly, it was hypothesised that enjoyment of food would be lower in children described by their caregivers as fussy with vegetables.

## **Methods**

### **Participants**

Caregivers with a 2 to 5 year-old child were invited to take part in a questionnaire study. A sample of 107 caregivers would provide sufficient statistical power for conducting regression analyses with eight independent variables (Cohen, 1992), and, in total, 297 caregivers participated.

### ***Procedure***

Ethical clearance was obtained for this study from the Loughborough University Institutional Review Board. Caregivers gave full informed consent before completing the study pack and were informed of their right to withdraw at any time. Approximately half of the caregivers (n=150) were recruited from a diverse sample of 17 toddler groups across Leicestershire, UK, following permission from group leaders. An opportunistic sample of caregivers (n=147) was also recruited via posters displayed on local noticeboards, online via social media and an online university noticeboard, as well as through articles in local newspapers, and via an interview on local radio. Caregivers were invited to participate in a study investigating how they offer vegetables to their young children. They were informed that the study involved completion of a one-off questionnaire which would take 10 to 15 minutes. Caregivers recruited from toddler groups who agreed to participate were then issued with an information sheet giving full details of the study, as well as a consent form to be signed if they wished

to take part, and a paper copy of the study questionnaire pack. Caregivers recruited via advertisements were directed to an online version of the questionnaire. The content of the online and paper questionnaires was identical.

### ***Measures***

A number of constructs surrounding caregiver offering of vegetables were measured in this study. These were derived from a previous qualitative study (Holley, Farrow, & Haycraft, 2016), and assessed using a combination of developed measures and newly-written questions.

#### *Identifying children's fussiness with vegetables*

To identify whether children were rated as fussy with vegetables, caregivers were asked to respond to a single item asking "Do you have difficulty getting your child to eat vegetables?". Caregivers responded using a scale coded from one to four (never, occasionally, often, always).

#### *Caregiver and child vegetable consumption: Brief Food Frequency Questionnaire (FFQ; Cooke, Wardle, & Gibson, 2003)*

An adapted version of Cooke et al.'s (2003) FFQ was used to measure caregivers' and children's vegetable consumption. Caregivers were asked to indicate how often they/their child ate: (1) raw vegetables (e.g. carrot sticks, celery); (2) cooked vegetables (including sweet potato but not potato); and (3) salad (e.g. tomatoes, lettuce). These three categories ensured that vegetables consumed in any form were included in caregiver estimates of children's consumption. For reference, caregivers were also issued with a guide to age appropriate portions of vegetables (Infant and Toddler Forum, 2013). The original FFQ asks caregivers to report their child's consumption on a scale ranging from 'never/rarely' to 'four or more times a day'. These categories were altered for this study to allow assessment of intake in age appropriate portions. Instead, caregivers reported their child's consumption of each of these three categories on an eight point scale, ranging from 'never/rarely' to

'four or more portions a day'. In order to calculate total vegetable consumption from these three categories, caregivers' responses were converted into equivalent portions per week. Responses of 'never/rarely' were assigned a score of 0, responses of 'one or two portions a week' were assigned a score of 1.5 and so on up to 'four or more portions a day' being scored 28. Total weekly vegetable consumption was then calculated by summing caregivers' responses for all categories, and this number was divided by seven to give average daily consumption.

#### *Quantifying caregiver reoffering of vegetables*

Caregivers were asked to quantify their reoffering of vegetables by responding to a single item asking "How many times will you re-offer your child a vegetable they have previously refused to eat on another occasion?". Responses were made on a 12-point scale ranging from 0 to more than 10 times.

#### *General parental feeding practices: Comprehensive Feeding Practices Questionnaire (CFPQ; Musher-Eizenman & Holub, 2007)*

The CFPQ is a 49 item questionnaire which measures a broad range of general feeding practices used by caregivers. A number of these which were expected to be related to children's consumption of vegetables were measured in this study, specifically: pressure to eat; modelling; healthy home environment; encourage balance and variety; and, involvement. The CFPQ has been validated (Musher-Eizenman & Holub, 2007) and used successfully with other UK caregivers with young children (e.g., Powell et al., 2011). While reliability for the modelling and pressure subscales was good in the current sample ( $\alpha = 0.82$  and  $0.76$ , respectively), the involvement, encouraging balance and variety, and healthy home environment subscales demonstrated slightly lower reliability ( $\alpha = 0.53$  to  $0.55$ ), as has been found in previous research (Musher-Eizenman, de Lauzon-Guillain, Holub, Leporc, & Charles, 2009).

#### *Caregivers' frequency of use of vegetable specific feeding practices*

A number of questions were written for the study to ascertain how often caregivers use various general feeding practices specifically to offer their child vegetables, as well as some additional items tapping vegetable specific practices which were born of a previous qualitative study by the authors (Holley et al., 2016). These items were verified as suitable using a small pilot study (data not reported here). Caregivers were asked to report how often they used each practice on a five-point scale, with responses ranging from 'never' (1) to 'always' (5). These practices were: modelling of eating vegetables; using food rewards to encourage consumption of vegetables; using non-food rewards to encourage consumption of vegetables; issuing threats in relation to not eating vegetables; using encouragement or pressure to eat vegetables; playing games with/relating to vegetables; involving their child in vegetable/meal choice/preparation; hiding vegetables in with other foods; using compromise when offering vegetables; and, reoffering vegetables in different forms. Raw scores for each of these questions were used in analyses.

*Child eating behaviour: Children's Eating Behaviour Questionnaire (CEBQ; Wardle et al., 2001)*

The CEBQ is a 35 item questionnaire measuring a variety of children's eating behaviours. Four of its subscales which were expected to be related to caregivers' reoffering and children's consumption of vegetables were administered to measure children's: enjoyment of food; slowness in eating; food fussiness; and food responsiveness. This measure has been shown to be reliable in other samples of UK caregivers of children of a similar age (e.g., Cooke et al., 2004). All four subscales demonstrated good reliability with this sample ( $\alpha= 0.77$  to  $0.89$ ).

***Statistical methods***

A series of Kolmogorov-Smirnov tests showed that all of the study's variables were not normally distributed; therefore non-parametric tests were used to test the study's hypotheses, wherever possible. Participants with missing data were not included in analyses where data was missing, but were included in analyses where the data allowed. Mann-Whitney U tests confirmed that caregivers

recruited online were significantly older ( $U=7748.00$ ,  $z=-3.62$ ,  $p<.001$ ), had children who were significantly older ( $U=6342.00$ ,  $z=-5.10$ ,  $p<.001$ ), and were more educated than those recruited in person ( $U=8057.00$ ,  $z=-3.79$ ,  $p<.001$ ). However, there was no significant difference between the children of caregivers recruited online and those recruited at toddler groups in terms of rated difficulty with feeding vegetables ( $U=21230.00$ ,  $z=-0.61$ ,  $p=0.54$ ), the number of times caregivers reoffered rejected vegetables ( $U=9998.00$ ,  $z=-0.88$ ,  $p=0.38$ ), caregivers vegetable consumption ( $U=9372.00$ ,  $z=-1.02$ ,  $p=0.31$ ), or child vegetable consumption ( $U=9722.00$ ,  $z=-0.42$ ,  $p=0.68$ ), therefore further analyses were conducted on the sample as a whole. Preliminary one-tailed Spearman's correlations were run to check for associations between the study variables with caregiver and child age. Caregiver age was significantly correlated with child vegetable consumption, caregivers' use of non-food rewards ( $r_s=-0.16$ ,  $p<0.01$ ) and providing vegetables in different forms ( $r_s=0.18$ ,  $p<0.01$ ). Child age was significantly correlated with children's general fussiness with food ( $r_s=0.17$ ,  $p<0.01$ ), caregivers' use of threats ( $r_s=0.20$ ,  $p<0.01$ ) and encouragement/pressure when feeding vegetables ( $r_s=0.26$ ,  $p<0.001$ ). Due to these associations, partial correlations (which controlled for parent and/or child age) were run between each of these factors and children's fussiness with vegetables.

Given the study's directional hypotheses and the findings of previous research (e.g., Farrow et al., 2009; Gregory et al., 2011; Tan & Holub, 2012; Webber et al., 2010), one-tailed Spearman's correlations were then used to investigate associations between children's fussiness with vegetables and the amount of vegetables caregivers and their children consume, caregivers' frequency of reoffering rejected vegetables, the general feeding practices that caregivers use, the vegetable specific feeding practices that caregivers use, and children's general eating behaviours. Due to the large number of analyses being conducted, a more stringent alpha of  $p\leq 0.01$  was utilised for all correlations. All significant correlates of children's fussiness with vegetables were then entered into a stepwise multiple regression to identify a model which could predict children's fussiness with

vegetables. An alpha of  $p < 0.05$  was adopted for the regression analyses, as a more stringent alpha of  $p \leq 0.01$  had previously been used to select the variables entered into the regression.

## **Results**

### ***Descriptive statistics***

Caregivers were predominantly mothers (91%) and ranged in age from 21 to 63 years (mean=40; SD=6.14), with child age ranging from 19 to 62 months (mean=38; SD=10.73). Caregivers were predominantly of White ethnicity (92%) and 67% had a degree or other form of higher university level education. Caregivers consumed an average of 22.66 portions of vegetables per week, which equates to an average of 3.24 portions of vegetables per day, while children consumed an average of 17.91 age appropriate portions per week, equivalent to 2.56 portions per day. This is higher than the UK national average vegetable consumption for both adults and children (Public Health England & Food Standards Agency, 2014). It should be noted that there was a large degree of variance in parent and child vegetable consumption, with a small number (2.5%) of children eating no vegetables each week. Descriptive statistics for reoffering of vegetables, general and vegetable specific feeding practices, as well as children's eating behaviours are displayed in Table 1. On average, caregivers reoffered previously rejected vegetable to their child 7.61 times, which is less than the 10-15 times required to acquire liking as outlined in previous research (e.g., Birch & Marlin, 1982; Sullivan & Birch, 1990).

The study sample's mean scores for the CFPQ subscales are comparable to means from similar samples (e.g., Musher-Eizenman & Holub, 2007). The mean scores for vegetable specific feeding practices suggest that modelling was the most commonly used method for encouraging children to consume vegetables, whilst compromising (e.g. on the order of foods eaten) was least commonly used. Together, the mean scores for these items indicate that most caregivers use these methods some of the time. Lastly, the mean scores generated for the CEBQ subscales were in line with those found in

previous research with similar samples (e.g., Ashcroft, Semmler, Carnell, van Jaarsveld, & Wardle, 2008; Haycraft, Farrow, Meyer, Powell, & Blissett, 2011).

**Table 1 here**

***Investigating relationships between children's fussiness with vegetables and caregiver and child consumption of vegetables.***

One-tailed Spearman's correlations revealed that children's fussiness with vegetables was negatively associated with children's weekly vegetable consumption ( $r_s = -0.42$ ,  $p < 0.001$ ), and there was a trend approaching significance between greater vegetable fussiness and lower caregiver vegetable consumption ( $r_s = -0.11$ ,  $p = 0.03$ ). Children's and caregivers' vegetable consumption were significantly positively correlated ( $r_s = .61$ ,  $p < 0.001$ ).

***Investigating relationships between children's fussiness with vegetables and caregivers' reoffering of vegetables, general feeding practices, vegetable specific feeding practices, and other child eating behaviours.***

A series of one-tailed Spearman's correlations (Table 2) were run to investigate associations between caregivers' reoffering of vegetables, general feeding practices, vegetable specific feeding practices, and children's eating behaviours with children's fussiness with vegetables (Table 2). Children's fussiness with vegetables was not significantly associated with caregivers' reoffering of vegetables or the general feeding practices used by caregivers. However, there were significant associations involving the vegetable specific feeding practices which caregivers used. Children's fussiness with vegetables was positively associated with caregivers' use of food and non-food rewards if children consume vegetables, encouragement/pressure to eat vegetables, compromise when feeding vegetables, and hiding vegetables within other foods. Fussiness with vegetables was also significantly

associated with children's eating behaviours; positively associated with general food fussiness and slowness in eating, and negatively associated with food responsiveness and enjoyment of food.

**Table 2 here**

### ***Predicting children's fussiness with vegetables.***

A stepwise regression was performed to identify the strongest predictor(s) of children's fussiness with vegetables (Table 3). All significant correlates of children's fussiness with vegetables from Table 2 were entered into a stepwise regression, along with significantly associated demographic variables. The regression variables comprised: use of encouragement/pressure with vegetables, hiding of vegetables within other foods, use of food rewards to encourage consumption of vegetables, use of other rewards to encourage consumption of vegetables, use of compromise when feeding vegetables, children's enjoyment of food, slowness in eating, fussiness with food in general, and children's food responsiveness, as well as caregiver and child age. A final model was identified where children's general fussiness with food, caregivers hiding vegetables within other foods, and caregivers' use of compromise when feeding vegetables explained 42% of the variance in children's fussiness with vegetables ( $F(3, 221) = 53.97, p < 0.001$ ). The relative contributions of the predictors to the final model can be seen in Table 3.

**Table 3 here**

### **Discussion**

This study aimed to investigate whether children's fussiness with vegetables was associated with (1) child and caregiver consumption of vegetables, (2) caregivers' reoffering of vegetables, (3) the general feeding practices used by caregivers, (4) the specific feeding practices caregivers use when feeding vegetables, and (5) children's general eating behaviours.

It was predicted that children who were fussier with vegetables would be reoffered vegetables fewer times, consume a smaller quantity of vegetables than children who were less fussy, and have caregivers who consume a smaller quantity of vegetables. While fussier children did consume a smaller quantity of vegetables than less fussy children, fussiness with vegetables was not associated with the number of times caregivers reported that they reoffered rejected vegetables. These findings suggest that caregiver reoffering is not a function of children's acceptance of vegetables, which is a promising finding for improving children's consumption of vegetables. Contrary to our hypotheses, children's fussiness with vegetables was not significantly associated with caregivers' consumption of vegetables, although there was a trend towards the hypothesised relationship. Moreover, while there was considerable variation in vegetable consumption in our sample, it should be noted that the caregivers in this study consumed, on average, more vegetables themselves than the most recent national averages in the UK (Public Health England & Food Standards Agency, 2014), which may also explain the lack of association between fussiness with vegetables and how many times caregivers reoffered rejected vegetables.

It was also hypothesised that caregivers of children who were fussier with vegetables would use more controlling feeding practices, and use specific vegetable feeding practices such as hiding vegetables within other foods more frequently than caregivers of less fussy children. There were no significant associations between children's fussiness with vegetables and the general feeding practices caregivers used (including controlling practices such as pressure to eat). However, children's fussiness with vegetables was associated with various methods which caregivers used to reoffer vegetables to their child. Caregivers with children who were fussier about eating vegetables reported using more rewards and pressure specifically when reoffering vegetables, and reported hiding vegetables more frequently and compromising more on vegetable consumption, than caregivers of less fussy children. Although previous cross-sectional research has found associations between caregivers' general feeding

practices and children's consumption of vegetables (Melbye, Øgaard, & Øverby, 2013; Vereecken, Legiest, De Bourdeaudhuij, & Maes, 2009; Vereecken et al., 2010), the findings of the present study suggest that vegetable intake is not a result of general parental feeding practices, but rather that parents may adapt their feeding practices around vegetables when children are low consumers. For example, caregivers' general use of pressure to eat was not associated with fussiness with vegetables, yet use of pressure specifically when feeding vegetables was. This is suggestive of caregivers adapting their feeding practices around specific problem foods.

In the present study, caregivers of children who were fussier with vegetables used methods such as pressure to eat vegetables and hiding vegetables more often than caregivers of children who were less fussy with vegetables. Use of pressure to eat has been shown in previous experimental research to lead to lower consumption of the pressured food (Galloway, Fiorito, Francis, & Birch, 2006), indicating the potentially detrimental effect this could have on children's consumption of vegetables. The use of this practice by caregivers in the current study might be indicative of these caregivers using methods which achieve short-term consumption, rather than long-term changes in food preferences. This finding is particularly significant and suggests two things. First, it suggests that caregivers should be informed of methods for successfully achieving consumption in their children. Second, it suggests that providing education about which methods to avoid may be appropriate, particularly amongst caregivers with children who are fussy eaters. However, due to the cross-sectional nature of this study causation cannot be assumed in the relationship between feeding practices such as hiding and pressure to eat and children's fussiness with vegetables. Here, it is possible that while caregivers' feeding practices are rational, they may be futile. With this in mind, longitudinal experimental research should be used to unpack these relationships.

It was predicted that children described by their caregivers as fussier with vegetables would have lower enjoyment of food than children described as less fussy with vegetables. Indeed, children's

fussiness with vegetables was associated with their other eating behaviours. Fussier children were less responsive to food, demonstrated lower enjoyment of food, had higher levels of general food fussiness and were reported to be slower eaters. This supports and extends previous research which has found general food fussiness to be associated with lower enjoyment of food and less food responsiveness (Svensson et al., 2011; Wardle et al., 2001). Furthermore, these findings indicate that interventions tackling general eating behaviours may be a promising avenue for further research. If, for example, general food fussiness can be reduced, this may impact on fussiness with vegetables and facilitate vegetable consumption. Having said this, it should be considered whether children's fussiness with food is a modifiable trait, with recent research demonstrating that food fussiness has underlying genetic influences (Fildes, van Jaarsveld, Cooke, Wardle, & Llewellyn, 2016).

This study explored the strongest statistical predictors of fussiness with vegetables. Caregivers' hiding of vegetables within other foods, caregivers' use of compromise in relation to feeding vegetables, and children's fussiness with food in general were the best statistical predictors, with general food fussiness being the strongest predictor. This highlights the strong relationship between children's fussiness with food in general and children's fussiness with vegetables, and the need for future interventions to address general food fussiness in order to tackle children's rejection of vegetables. It also emphasises the need for further caregiver education on the possible detrimental or limited success of methods such as hiding which, although seem effective in the short term, may not result in long term success with feeding vegetables (Pescud & Pettigrew, 2014). Moreover, it suggests that caregivers' use of compromise, which could be considered as a more permissive feeding practice, is associated with children's fussiness with vegetables. It is possible that some caregivers may become more permissive in their feeding behaviors in response to their children's rejection of vegetables, giving the child a high degree of control over their eating. However, this may have a further detrimental influence on children's liking and consumption of vegetables, with research suggesting

that authoritative feeding styles (which balance control over children's diet at the same time as giving the child autonomy) are associated with a more healthy child diet (e.g., Patrick et al., 2005).

This study is novel as it is the first to explore the association between the feeding practices caregivers use specifically with vegetables and children's fussiness with vegetables. In order to adequately assess possible methods of improving children's consumption of vegetables it is crucial to ensure that practices investigated are explored with specific reference to vegetables. The relatively large sample allowed us to analyse a number of caregiver and child factors, as well as children's vegetable consumption. However, there are still a number of factors that might influence feeding style and dietary habits not controlled for in this study, such as duration of breast feeding and number of siblings. Children's sensory sensitivity and neophobia are also other factors not included in this study which previous research suggests are related to children's vegetable consumption (e.g., Coulthard & Blissett, 2009; Galloway, Lee, & Birch, 2003). Future research should seek to investigate the relative association of these variables to children's fussiness with vegetables. The cross-sectional nature of the data is a limitation as it prevents us from determining cause and effect. Future research could improve on this by analysing observations of mealtimes as an objective measure of feeding behaviour. A further limitation of the current study is its relatively homogenous and well educated sample, meaning that the study findings may not be generalisable to other cultural or socio-economic groups. Caregivers who were recruited online were significantly more educated than those recruited from toddler groups, which may have influenced the findings of this study. Moreover, this high level of education might be associated with the relatively high vegetable consumption seen in both the caregivers and children in this sample. Additionally, the repeatability of the question used to quantify caregivers' reoffering was not explored, and future research should seek to confirm the accuracy of reports of reoffering. Lastly, it is apparent that although significant correlates and predictors of fussiness were identified, the relative values of these were small, and so the associated expected practical consequences of implementing changes based on these findings should be considered.

In conclusion, this study highlights the significant role that child characteristics, such as their fussiness with vegetables, can play in the feeding practices caregivers use when reoffering vegetables. Furthermore, it suggests that the caregiver-child feeding dynamic is complex and that caregivers adapt their feeding practices specifically for vegetables. It also underlines the substantial influence that child characteristics can have on children's consumption of vegetables. These findings provide valuable insight into the way that children's fussiness with vegetables is associated with caregivers' feeding of vegetables. In turn, these findings can be used to tailor interventions to minimise caregivers' use of feeding practices which - when faced with a child who is fussy with vegetables - may serve to increase the child's rejection of vegetables. Moreover, these findings suggest that interventions which target fussiness with vegetables in general rather than consumption of a specific vegetable are an important avenue for further research. In summary, we need to better understand how feeding practices are related to specific foods that parents have difficulty feeding to their children – whether healthy or non-healthy foods – an area in which detailed research is currently lacking.

## **Key messages**

- Vegetable consumption is known to be important for health yet too many children eat too few vegetables.
- This study investigated associations between a number of caregiver and child factors and children's fussiness with vegetables.
- Caregivers general feeding practices were not associated with children's fussiness with vegetables, although the specific practices which caregivers use in response to children's rejection with vegetables were.
- These findings indicate that provision of information on how to deal with food rejection may be a useful tool in public health efforts to increase vegetable intake in children.

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## Tables

**Table 1:** Descriptive statistics for reoffering of vegetables, general and vegetable specific feeding practices, as well as children's eating behaviour.

Measure	Mean (SD)	Median	IQR	Min	Max
<b>Reoffering of refused vegetables</b>	7.61 (3.82)	11.00	7.50	0.00	11.00
<b>General feeding practices</b>					
Modelling healthy eating	4.42 (0.68)	4.75	1.00	1.00	5.00
Encourage balance and variety	4.42 (0.51)	4.50	0.75	2.25	5.00
Healthy food environment	3.89 (0.70)	4.00	1.00	1.00	5.00
Pressure to eat	3.09 (0.92)	3.25	1.25	1.00	5.00
Involvement in food planning/ preparation	3.41 (0.92)	3.50	1.00	1.00	5.00
<b>Vegetable specific feeding practices</b>					
Modelling of eating vegetables	4.25 (0.92)	4.00	1.00	1.00	5.00
Encouragement/ pressure to eat vegetables	3.35 (1.01)	3.00	1.00	1.00	5.00
Involvement with choosing and preparation	3.18 (0.82)	3.00	1.00	1.00	5.00
Hiding vegetables within other foods	2.79 (1.16)	3.00	2.00	1.00	5.00
Serving vegetables in different forms	2.76 (0.96)	3.00	1.00	1.00	5.00
Playing games with eating vegetables	2.45 (1.16)	3.00	2.00	1.00	5.00
Offering food rewards in exchange for consumption	2.32 (1.16)	2.00	2.00	1.00	5.00
Offering other rewards in exchange for consumption	2.01 (1.07)	2.00	2.00	1.00	5.00
Using threats for if vegetables are not eaten	1.56 (0.91)	1.00	1.00	1.00	5.00
Compromising on the order or amount consumed	1.27 (0.70)	1.00	0.00	1.00	5.00
<b>Children's eating behaviours</b>					
Enjoyment of food	3.91 (0.77)	4.00	1.00	1.00	5.00
Slowness in eating	2.77 (0.76)	2.75	1.00	1.00	5.00
Food fussiness	2.74 (0.77)	2.67	1.00	1.00	5.00
Food responsiveness	2.60 (0.82)	2.60	1.10	1.00	5.00
Fussiness with vegetables	2.16 (0.82)	2.00	1.00	1.00	4.00

IQR=Interquartile range; SD = Standard Deviation

**Table 2:** Associations between children’s fussiness with vegetables with caregivers’ reoffering of vegetables, general feeding practices, vegetable specific feeding practices, and children’s eating behaviours.

	Children’s fussiness with vegetables	
	r	p
<b>Reoffering of refused vegetables</b>	0.03	0.34
<b>Caregivers’ general feeding practices</b>		
Modelling healthy eating	-0.05	0.18
Encourage balance and variety	-0.10	0.05
Healthy food environment	-0.10	0.04
Pressure to eat	-0.04	0.24
Involvement in food planning/ preparation	-0.02	0.35
<b>Caregivers’ vegetable specific feeding practices</b>		
Modelling of eating vegetables	-0.01	0.46
Encouragement/ pressure to eat vegetables <sup>b</sup>	<b>0.14</b>	<b>0.01</b>
Involvement with choosing and preparation	-0.06	0.18
Hiding vegetables within other foods	<b>0.30</b>	<b>0.00</b>
Serving vegetables in different forms <sup>a</sup>	0.11	0.03
Playing games with eating vegetables	0.03	0.31
Offering food rewards in exchange for consumption	<b>0.19</b>	<b>0.00</b>
Offering other rewards in exchange for consumption <sup>a</sup>	<b>0.21</b>	<b>0.00</b>
Using threats for if vegetables are not eaten <sup>b</sup>	0.09	0.07
Compromising on the order or amount consumed	<b>0.14</b>	<b>0.01</b>
<b>Children’s eating behaviours</b>		
Enjoyment of food	<b>-0.37</b>	<b>0.00</b>
Slowness in eating	<b>0.25</b>	<b>0.00</b>
Food fussiness <sup>b</sup>	<b>0.60</b>	<b>0.00</b>
Food responsiveness	<b>-0.16</b>	<b>0.00</b>

Significant correlations ( $p \leq .01$ ) are denoted in bold

<sup>a</sup> Partial correlation controlling for caregiver age; <sup>b</sup> partial correlation controlling for child age

n ranges from 251 to 287 due to missing data

**Table 3:** Stepwise regression model showing predictors of children’s fussiness with vegetables, as reported by caregivers (n=239), with confidence intervals in parentheses

	<i>b</i>	<i>SE B</i>	$\beta$	p
Step 3 (final model)				
Hiding vegetables within other foods	0.11 (0.03, 0.19)	0.04	0.15	0.01
Compromise on the order or amount consumed	0.14 (0.00, 0.27)	0.07	0.11	0.04
Food fussiness	0.64 (0.52, 0.75)	0.06	0.59	0.00