



Taylor, C., & Emmett, P. (2019). Picky eating in children: Causes and consequences. *Proceedings of the Nutrition Society*, 78(2), 161-169. <https://doi.org/10.1017/S0029665118002586>

Peer reviewed version

License (if available):
Unspecified

Link to published version (if available):
[10.1017/S0029665118002586](https://doi.org/10.1017/S0029665118002586)

[Link to publication record in Explore Bristol Research](#)
PDF-document

This is the author accepted manuscript (AAM). The final published version (version of record) is available online via Cambridge University Press at <https://www.cambridge.org/core/journals/proceedings-of-the-nutrition-society/article/picky-eating-in-children-causes-and-consequences/34921F967B9F37046962CA866DC199C3>. Please refer to any applicable terms of use of the publisher.

University of Bristol - Explore Bristol Research

General rights

This document is made available in accordance with publisher policies. Please cite only the published version using the reference above. Full terms of use are available: <http://www.bristol.ac.uk/pure/about/ebr-terms>

Picky eating in children: causes and consequences

Caroline M Taylor*, Pauline M Emmett

Centre for Academic Child Health, Bristol Medical School, University of Bristol, UK

*Corresponding author:

Centre for Academic Child Health, Bristol Medical School, University of Bristol, 1-5
Whiteladies Road, Bristol BS8 1NU, UK

Caroline.m.taylor@bristol.ac.uk

0117 42 83099

Short title: Picky eating in children

Abstract

Picky eating is a common behaviour in early childhood. There is no universally accepted definition of picky eating, nor is there agreement on the best tool to identify it. 'Causes' of picky eating include early feeding difficulties, late introduction of lumpy foods at weaning, pressure to eat, and early choosiness especially if the mother is worried by this; protective factors include provision of fresh foods and eating the same meal as the child. The 'consequences' for the child's diet include poor dietary variety and a possible distortion of nutrient intakes, with low intakes of iron and zinc (associated with low intakes of meat, and fruits and vegetables) being of particular concern. Low intakes of dietary fibre as a result of low intakes of fruit and vegetables are associated with constipation in picky eaters. There may be developmental difficulties in some children with persistent picky eating. There is little evidence, however, for a consistent effect of being a picky eater on growth trajectories. There may be a small subgroup of children in whom picky eating does not resolve who might be at risk of thinness during adolescence, or of developing an eating disorder or adult picky eating: these children need to be identified at an early age to enable support, monitoring and advice to be offered to parents. Strategies for avoiding or ameliorating picky eating include repeated exposures to unfamiliar foods, parental modelling of eating fruits and vegetables and unfamiliar foods, and creation of positive social experiences around mealtimes.

Keywords: Picky eating, Child, Diet, Fussy eating, Selective eating, Child development, Growth

Introduction

Picky eating (alternatively known as fussy, faddy, choosy or selective eating) is a common behaviour in early childhood. It can cause considerable stress to parents/caregivers and have a negative impact on family relationships⁽¹⁾, but it generally resolves with minimal or no intervention by healthcare providers.⁽²⁾ It is largely a phenomenon of developed countries and involves a complex set of interactions between parents/carers and children centred around food selection and consumption.⁽³⁾

There is no agreement on a formal definition of picky eating, although it is generally accepted to include rejection or restriction of familiar foods and unfamiliar foods, and thus including an element of neophobia.⁽³⁾ To add further complication, there are a variety of tools used for the assessment of picky eating and consequently there is a wide range of prevalence reported.⁽²⁾ The ‘causes’ and ‘consequences’ of picky eating are not well understood because of these inconsistencies and because of heterogeneity in study designs. This is further compounded by a lack of longitudinal observational data, with most studies using only cross-sectional data. Addressing these problems would enable evidence-based contributions to inform more consistent advice for parents and carers from healthcare providers.

This review will first consider the effects of the variety of definitions and assessment tools on the reported prevalence of picky eating. The possible ‘causes’ of picky eating, including demographics, parental characteristics, early feeding practices and psychosocial factors, will be described. Knowledge of the effects on the child’s diet, both as nutrients and diet quality, and in relation to recommended daily intakes will be described, with a focus on the few data available on longer-term patterns of intake. The ‘consequences’ likely to result from any dietary differences between picky and non-picky children, including effects on body weight and composition, growth, eating disorders and psychosocial difficulties will be outlined. There will be a particular focus on data from the UK Avon Longitudinal Study of Parents and Children (ALSPAC)⁽⁴⁾, which is one of the most comprehensive sources of longitudinal data on the causes and consequences of picky eating, both short- and long-term. The review will conclude with suggestions for parents/carers and professionals to avert or ameliorate picky eating behaviour.

Definition and prevalence

The most commonly accepted definition of picky eating was proposed by Dovey *et al.* ⁽³⁾ in which picky/fussy eaters are children ‘who consume an inadequate variety of foods though rejection of a substantial amount of food that are familiar (as well as unfamiliar) to them’. Dovey *et al.* regard food neophobia (reluctance to eat, or the avoidance of, new foods) as a somewhat separate construct, while recognising that the two factors are inter-related, and that both contribute to the rejection or acceptance of foods, particularly of fruits and vegetables. Alternative definitions include specific mention of restriction of intake of vegetables, strong food preferences, provision of meals that are different from those of the caregivers, special methods of food preparation, consumption of inadequate amounts of food, and disruption of daily routines that are problematic to the child, parent or parent–child relationship^(5; 6; 7; 8; 9). It is clear, however, that picky eating is not synonymous with Avoidant/Restrictive Food Intake Disorder (ARFID; previously known as Selective Eating Disorder), which has a very specific definition in the *Diagnostic and Statistical Manual of Mental Disorders (DSM)-V*, including the presence of nutritional deficiency as a result of inadequate food intake, failure to gain weight in children, a decline in psychological function, and a dependency on supplements to maintain nutritional health.⁽¹⁰⁾

There are several questionnaires available to identify picky eating, designed for completion by the parent/carer, in which multiple aspects of the child’s feeding behaviour are assessed. Several of these questionnaires have been validated. Examples include the Children’s Eating Behavior Questionnaire (CEBQ), the Child Feeding Questionnaire, the Lifestyle Behaviour Questionnaire, the Stanford Feeding Questionnaire and the Preschooler Feeding questionnaire.⁽²⁾ Despite Dovey’s caution about the inclusion of food neophobia in the definition of picky eating, several of the questionnaires have subscales that include elements of neophobia. For example, the ‘fussiness’ subscale of the Children’s Eating Behaviour Questionnaire includes three out of six statement questions that relate directly to neophobia (‘My child enjoys tasting new foods’/‘My child refuses new foods at first’/‘My child is interested in tasting food s/he hasn’t tasted before’) (used for example by Hendy *et al.* ⁽¹¹⁾; Morrison *et al.* ⁽¹²⁾; Tharner *et al.* ⁽¹³⁾). An alternative approach to multi-element questionnaires is to ask the caregiver a single question on whether their child is a picky eater (used for example by Mascola *et al.* ⁽⁵⁾; van der Horst *et al.* ⁽¹⁴⁾; Orun *et al.* ⁽¹⁵⁾). Although this approach is straightforward and enables clear classifications, it has the disadvantage of requiring the carer to create their own definition of picky eating, which may or may not align with the definition that the researcher intends. To address this, studies from ALSPAC have

used a single question asking whether the child has definite likes and dislikes for food, with the responses ‘No/Yes, quite choosy/Yes, very choosy’. Although this does not capture all the proposed facets of picky eating behaviour, it does avoid the difficulty of forcing the caregiver to use their own definition of picky eating, and is similar to what might be asked of a parent by a healthcare provider.⁽²⁾ This question, which is similar to that used in other recent studies^(5; 14; 15), was asked at four timepoints in ALSPAC (24, 38, 54 and 65 months old), which enables both identification of picky eaters at a single time point and identification of persistent picky eaters, who may be more at risk of adverse health and developmental outcomes than transient picky eaters. It also enables modelling of outcomes that occur after the exposure, enabling a greater degree of confidence in the causality of associations than in a strictly cross-sectional approach. The lack of an accepted definition of picky eating amongst researchers and the lack of an accepted and validated method of identification that is used universally is a hinderance to further research: it makes it difficult to compare the results of studies effectively.

There is a wide range of prevalence found in different studies (6%–50%)⁽²⁾, which is likely to reflect differences in study design and assessment tools, but may also be due to social or cultural factors. There is more consensus on the relation of prevalence to the child’s age: in ALSPAC prevalence was 10% at age 24 months, peaking at 38 months (15%) and then declining at 54 and 65 months (14% and 12%, respectively). Other studies have also found the peak age to be at about 3 years old^(7; 16) although one found the peak age to be at 6 years⁽⁵⁾.

There is little known about whether some children sustain picky eating behaviour once it is established, or how this relates to later outcomes such as eating disorders or adult picky eating. Although some studies have found the prevalence to be stable with increasing age^(15; 17; 18), in ALSPAC it was found that children with picky eating identified at the earliest time point at which it was measured (24 months) were more likely to be picky at the next time point than if the picky eating was newly incident at a later time point, suggesting that early picky eating behaviour is more persistent⁽²⁾. The prevalence of picky eating was moderately stable between age 4 and 6 years in a group of Norwegian children, with 50% being picky at both ages.⁽¹⁹⁾ Some studies have shown the prevalence to be stable beyond the age of 3 years^(15; 20), even up to age 11 years⁽¹⁸⁾. In the study in which the prevalence increased up to 6 years of age and then plateaued (USA), this was interpreted as evidence of two groups of picky eaters: one in whom recovery was relatively swift and another in whom the behaviour

persisted⁽⁵⁾. Few studies have attempted to identify persistent picky eaters systematically and it is difficult to do, bearing in mind that it requires a longitudinal study and a consistent identification strategy, as well as a definition of persistence and a means of categorisation. Cardona Cano *et al.*^{(16);(21)} identified four picky eating trajectories (persistent/remitting/late onset/never) from assessments at age 1.5, 3 and 6 years, and used the classification to look at associations with child mental health. Children in the ALSPAC cohort have been identified as early or late onset picky eaters, and the early picky eaters into subcategories of persistent or non-persistent, based on the scoring patterns for the identifying questions: this categorisation has been used to date for diet analysis⁽²²⁾, but could also be used in studies of predictors of picky eating, and of growth and body composition and other health outcomes.

Causes of picky eating

Accepting that the peak prevalence of picky eating occurs at about age 3 years, factors that are predictive of a child becoming a picky eater as a pre-schooler can occur during three distinct phases: before and during pregnancy, in the early feeding phase (first year of life, reflecting early feeding practices), and in the second year of life (reflecting parental feeding styles in response to increasing child autonomy). They can alternatively be categorised as factors related to the child, to the parent/caregiver, and to child–parent interaction. Some of these predictors are ‘fixed’, but others can inform the development of advice and strategies for parents and caregiver to avert or ameliorate picky eating behaviour in their child. It is unlikely, however, that any of these predictors acts in isolation: rather, there is a complex mix of parental and child-related characteristics that interact.

With regard to ‘fixed’ predictors, picky eating at 38 months in ALSPAC was associated with a greater maternal age, maternal smoking (yes), higher maternal social class, lower pre-pregnancy body mass index, higher maternal educational attainment, lower parity, and the infant being of lighter birthweight and male.⁽²⁾ Other studies, however, have found boys and girls to be equally affected,⁽²³⁾ with the presence of siblings being protective⁽⁷⁾. Several studies have investigated familial similarity for food neophobia (rather than picky eating *per se*) and found low to moderate similarity, suggesting a moderate degree of heritability. In a study of more than 5000 twin pairs and their parents, it was found that neophobia was highly heritable, with a heritability estimate of 0.78 (95% CI 0.76, 0.79), although about one-quarter of the phenotypic variation was accounted for by environmental factors⁽²⁴⁾. Genetic variation in sensitivity to bitterness (classified by being tasters/non-tasters of 6-*n*-propylthiouracil) may

play a role in the development of vegetable acceptance and consumption in early childhood⁽²⁵⁾. These studies endorse the call by de Barse *et al.* ⁽²⁶⁾ that parental picky eating should ideally be accounted for in statistical analyses.

As early as the first month of life, babies aged 2 and 4 weeks who were later identified as picky eaters had a different sucking pattern from non-picky eaters, with fewer sucks per session⁽²⁷⁾. Reduced duration of breast-feeding and late introduction of complementary feeding have been shown to predict later picky eating in some studies^(28; 29), but another study found no difference in picky eating prevalence in children who were breast fed, formula fed, or a mixture of both⁽³⁰⁾. Evidence from the Generation R study in the Netherlands suggests that breastfeeding does not predict later picky eating. Breastfeeding prevalence, early feeding practices and timing of complementary feeding were assessed in nearly 5000 infants at 2, 6 and 12 months old and picky eating was assessed at 4 years old with the food fussiness subscale of the CEBQ. In adjusted analyses, there was no difference in the prevalence of picky eating in children who were never breastfed compared with those who were breastfed for 6 months or more. However, those who were breastfed for less than 2 months had a higher food fussiness score than those who were breastfed for 6 months or more. Early feeding of vegetables, however, was protective against later picky eating: those children who had vegetables introduced into their diets between 4 and 5 months of age had lower scores than those who had their introduction delayed until after 6 months. Early introduction of fruit or other solids were not associated with picky eating.

Modelling of positive maternal eating behaviour is frequently cited as being important in averting picky eating in the child. Indeed, in a study of Australian mother–child pairs, maternal healthy eating when the child was 1 year old was predictive of vegetable consumption when the child was 2 years old⁽³¹⁾. Further, when the children were 2–4 years old, maternal healthy eating was associated with a lower prevalence of picky eating in the children 1 year later ⁽³²⁾. Maternal pressure to eat in this study was also associated with picky eating, and this was mediated by concern about the child being underweight ⁽³³⁾. In a more detailed study of pressure to eat, data from the Generation R study showed a bidirectional association with picky eating behaviour: picky eating in 4-year-olds prospectively predicted parental pressure to eat at age 6 years, and pressure to eat at age 4 years predicted picky eating at age 6 years. This was interpreted as suggesting that parental feeding strategies were developed in response to children’s food avoidant behaviour, whilst having a counterproductive effect on picky eating behaviour ⁽³⁴⁾. Combining some of these traits in a

study of girls only, mothers who provided a positive model of eating behaviour by consuming more fruits and vegetables were less likely to pressure their children who in turn, were less likely to be picky eaters ⁽³⁵⁾.

In a study of Norwegian mothers and children, both child and maternal temperament (child emotionality and maternal negative affectivity, respectively) when the child was age 1.5 years were found to increase the risk of later picky eating⁽⁷⁾. Maternal and paternal internalising problems, which are symptoms of anxiety and depression, during pregnancy and in the child's early years, were prospectively associated with picky eating in preschool in the Generation R study.⁽³⁶⁾ Children who had more sensory sensitivity are at greater risk of becoming a picky eater, as are those who parents have higher levels of sensitivity and lower levels of structuring.⁽¹⁹⁾

Bringing data together from these three phases, a study from ALSPAC modelled predictors in about 6000 children for each of these phases separately and then brought the predictors that were significant together into a final model.⁽³⁷⁾ During the first year of life, feeding difficulties and late introduction of lumpy food (>9 months) was associated with an increased likelihood of the child being a picky eater at 38 months. In the second year, the strongest predictor was the child being choosy at 15 months old. 56% of children were classified as being choosy at this time point. If the mother was not worried by this, then only 17% went on to be a picky eater at 38 months, but this rose to 50% if the mother was worried by this choosiness. Provision of fresh fruit and eating the same meal as the child were protective against later picky eating, while providing ready-prepared food predicted later picky eating. In contrast to the finding in Generation R⁽³⁶⁾, maternal anxiety and depression during pregnancy or during the first years of the child's life were not associated with picky eating in the child in the model adjusted for all the predictors listed above.

Consequences of picky eating

Diet: nutrients, food groups/foods and diversity

The primary consequence of being a child who is a picky eater is the effect it has on dietary intake, and this is a potential mediator for adverse health and development outcomes. Indeed, adverse effects on diet are encompassed in the proposed definitions of picky eating behaviour. Overall, picky eating could be hypothesized to lead to a reduction of food intake

with a distortion of nutrient intake though poor dietary variety. The evidence for these effects, however, is inconclusive, with the exception of a lower intake of vegetables in picky eaters, which is a frequent finding^(14; 16; 17; 22; 27; 35; 38; 39; 40; 41) although not universal^(42; 43). There are several reasons for these disparities. As described earlier, there are several different tools used to identify picky eaters, and different methods of grouping categories of respondents. Results may also vary by country, reflecting differences in food cultures and feeding practices. Methods of collection of dietary data vary, and include standard methods such as 24-h recalls (e.g. van der Horst *et al.*⁽¹⁴⁾; Dubois *et al.*⁽¹⁷⁾), food frequency questionnaires (FFQ) (e.g. Taylor *et al.*⁽⁴⁰⁾; Antoniou *et al.*⁽⁴⁴⁾), 2-, 3- or 4-day food diaries (e.g. Taylor *et al.*⁽²²⁾; Rohde *et al.*⁽⁴²⁾), and combinations of methods^(45; 46), as well as alternative methods such as recording food selection from a pre-stocked chiller box⁽²⁷⁾. ALSPAC includes data from both 3-day diet diaries and FFQ at regular time points from early infancy up to age 13 years.⁽⁴⁷⁾ Some studies have not included a control group of non-picky eaters, which limits synthesis of data to comparisons with recommended dietary allowances and estimated average requirements, which are not always available for the country in which the study is carried out. It is also important to know what proportion of children have intakes that are below recommended daily allowances to enable interpretation of the intakes.

Many studies have reported that energy intakes in picky children are not different from those of non-picky children and adequate in comparison with reference nutrient intakes (RNIs)^(22; 35; 41; 42; 45; 46). However, others have reported a higher energy intake in picky eaters⁽³⁰⁾, perhaps due to a high intake of energy-dense foods such as confectionary and savoury snacks⁽⁴¹⁾, or intakes lower than non-picky children^(16; 17; 48) or substantially below the RNI⁽⁴⁹⁾. ALSPAC, using 3-day diet diaries, did not find any differences in energy intakes between picky eaters and non-picky eaters at ages 3.5, 10 and 13 years⁽⁵⁰⁾. Other studies have suggested that energy intakes are not affected at some ages, but adversely affected at others: at 7–8 months old, the children of caregivers who had reported that they considered their child to be a picky eater had a similar energy intake to non-picky children, but at 9–11 months old, intakes of energy and other nutrients were significantly lower⁽⁴³⁾. However, at ages below 12 months children are still learning about food tastes and textures and are too young to experience neophobia, so should not be considered picky eaters in the sense described in this paper. Protein intakes generally mirror those of energy, so that studies showing lower energy intakes in picky eaters than non-picky eaters tend also show lower

protein intakes^(17; 48), although it is not always clear whether the protein intake is adequate in regard to RNIs or not.

There is a similar mixed picture for micronutrients, but with some consensus around low intakes of zinc and iron in picky eaters^(22; 39; 45; 46; 49). In the few studies that have reported on dietary fibre intakes, there is consensus that intakes in almost all children are low but they are particularly low in picky eaters, reflecting their low intakes of vegetables and fruits^(40; 48; 50). Low intakes of meat, especially carcass meat (rather than processed meat) often contribute to low intakes of zinc and iron^(14; 22; 30; 38; 48; 50).

The impact of picky eating on dietary diversity and variety has been studied less frequently, but picky eaters have been shown to have less diversity and variety at 24–36 months of age⁽⁴⁵⁾ or to eat fewer different items of food⁽¹⁶⁾. At a younger age of 12–16 months, perhaps before picky eating behaviour is fully expressed, Byrne *et al.*⁽⁵¹⁾ found no difference in dietary diversity score, or intakes of fruit, vegetables or meat, between picky and non-picky eaters. Brown *et al.*⁽³⁹⁾ used the Healthy Eating Index-2010 (HEI) to evaluate the overall dietary quality of low-income pre-schoolers identified as picky eaters with the CEBQ food fussiness subscale: there was a negative relationship with the overall HEI with scores driven by lower intakes of whole fruit, total vegetables and total protein foods in picky eaters than in non-picky eaters. The authors noted that their results were consistent with the reports of a lower number of foods eaten, especially fruits and vegetables. In a smaller study in girls up to age 15 years reporting only on fruit and vegetable intakes, both picky and non-picky children consumed less than the recommended amount of fruits and vegetables, but picky eaters ate slightly less vegetables than the non-picky eaters at all ages⁽³⁸⁾.

ALSPAC is one of the very few studies that has been able to document detailed long-term differences in diet (including nutrients, comparisons with RNIs, and foods/food groups) in a large group of children identified as picky or non-picky eaters, with a single question at age 3 years, using both FFQ and 3-day food records at intervals up to age 13 years (see Table 1). At age 3.5 and 7.5 years, using the 3-day food record, picky eaters had lower intakes of meat, fish, fruit and vegetables than non-picky eaters, and this was reflected in lower intakes of iron, zinc, carotene and dietary fibre, with substantial proportions below the RNI for iron, zinc and dietary fibre. There were no significant differences in energy intake, which was adequate in comparison with estimated average requirements. The differences in intakes of the food groups was also evidenced at age 10 and 13 years, particularly for meat and

vegetables, although less so at age 13 years⁽⁵⁰⁾. Similar results were obtained using data from the FFQ. Using a longitudinal classification between age 2 and 5.5 years to identify persistent picky eaters, there were again, no significant differences in energy intakes between any of the groups. Mean protein intake was 8% lower in children who were ‘persistent’ picky eaters than those who had ‘never’ been a picky eater, but no child had an inadequate intake. Mean intakes of carotene, vitamin D, iron, zinc and selenium were all lower (3%–16%) in the ‘persistent’ group than in the ‘never’ group, with substantial proportions having intakes below the lower RNI for retinol and zinc. Intakes in the ‘non-persistent’ group were generally intermediate between the ‘persistent’ and ‘never’ groups. The ‘persistent’ group ate 40% less carcass meat, 48% less vegetables and 33% less fruit than the ‘never’ group. Similar results to those for the ‘persistent’ group were found for a group classified as ‘late-onset’ picky eaters. Overall, picky eating did not result in a comprised macronutrient intake, but there were concerns about intakes of zinc and iron.

These studies indicate long-term effects on diet that point to an important role for early intervention by parents to increase the quality of their children’s diets from an early age. This should include more nutrient-rich and fibre-rich foods, especially fruits and vegetables.

Health and development

There has been little systematic study of health outcomes of picky eating other than growth and to a lesser extent body composition. Several studies have shown that picky eating is associated with a greater risk of being underweight and having poor growth^(6; 20; 52; 53; 54; 55). This could be driven by energy intakes lower than requirements, possibly in combination with low intakes of zinc and iron^(22; 35), which are critical for optimal growth. Others, however, have found an association of picky eating with being overweight⁽³⁰⁾. As discussed by Berger *et al.*⁽³⁸⁾ the interpretation of most of these studies are limited by their cross-sectional design, meaning that it is not possible to establish causation. In a longitudinal study of weight, height, BMI and body composition in ALSPAC, the growth of children (boys and girls) up to age 17 years who were identified as picky eaters at age 3 years were assessed against reference growth charts for British children⁽⁵²⁾. The mean weights, heights and BMIs of the picky eaters were consistently above the 50th centile, even though they were below those of the non-picky eaters, providing reassurance that their growth trajectories are normal⁽⁵²⁾. However, there was evidence of a slightly increased prevalence of thinness in picky eaters. It is also of note that the non-picky children in ALSPAC had a growth trajectory well

above the 50th centile of the growth charts so it is possible that in a population in which the children's growth was generally closer to the 50th centile the trajectories of the picky eaters would be below the 50th centile and therefore of greater concern. Similar results to those in the ALSPAC study in the UK were found in a group of US girls up to age 15 years, in whom picky eaters tracked about 15 centile points below the non-picky girls who tracked along the 65th centile⁽³⁸⁾. This difference in the location of the trajectories relative to the centiles could reflect a difference in the prevalence of overweight and obesity in the two cohorts and/or the use of different centile charts.

With regard to body composition in the ALSPAC study, being a male picky eater was associated with a lower lean mass index than being a non-picky eater, but there was no association with percentage body fat or fat mass index and there were no associations at all in females⁽⁵²⁾. Participants identified as picky eaters at age 4 years in the Generation R study in the Netherlands had lower standard deviation scores for BMI, fat mass index and fat-free mass index at age 6 years than non-picky eaters, and, as in ALSPAC, a higher risk of being underweight⁽⁵⁶⁾. There is a need for further longitudinal data on this point, but it seems likely that there is a subsection of picky eaters who are at risk of being underweight who need early identification and intervention or surveillance.

Picky eating has been identified as a risk factor for subsequent anorexia nervosa in one observational study⁽¹⁸⁾, although in a later extension of that study picky eating was not found to be associated with later anorexia or bulimia⁽⁵⁷⁾ making interpretation difficult. In addition, the statistical power of these studies has been questioned and this highlights the limitations of observational studies for studying outcomes that are relatively rare⁽⁵⁸⁾. Adult picky eating does occur and has been shown to cause distress and social impairment⁽⁵⁹⁾: it has been shown to be associated with parental feeding practices in childhood (particularly pressure to eat), childhood picky eating, higher disgust sensitivity and experiencing an adverse food event⁽⁶⁰⁾.

Picky eating has been associated with a range of other adverse behavioural outcomes, compromising both externalising and internalising behaviours⁽⁶¹⁾. Longitudinal data on picky eating at 1.5, 3 and 6 years old from nearly 4000 participants in Generation R classified into four trajectories of picky eating (persistent/remitting/late-onset/never) were used to identify any associations with emotional problems, behavioural problems and pervasive developmental problems at 7 years old⁽²¹⁾. Persistent picky eating predicted pervasive developmental problems, but not behavioural or emotional problems. The other trajectories

were not predictive of any adverse outcomes and so it was concluded that remitting picky eating was part of normal development.

Constipation is a common condition in children, affecting up to 30% of school-age children in the UK and accounting for about 3% of paediatric consultations^(62; 63), and seems to affect children who are picky eaters disproportionately. In a Korean paediatric gastroenterology clinic, constipation was mentioned as a characteristic of being a picky eater by about 27% of caregivers compared with 13% in a control group. Constipation was more common in picky eaters than non-picky eaters in Taiwan (prevalence of 19% vs 10%)⁽⁶⁴⁾. In Generation R, Tharner *et al.*⁽¹³⁾ showed a bidirectional relationship between picky eating and constipation with a 'vicious circle' being set up between them. Although low dietary fibre intakes have been documented in picky eaters, with intakes found to be lower in picky eaters than non-picky eaters, intakes in both groups are generally below those recommended^(35; 48; 65). In the ALSPAC study the difference in intake for picky eaters compared with non-picky eaters at age 3.5 years was -1.4 (95% CI -1.6, -1.2) g non-starch polysaccharide (NSP) fibre/day and dietary fibre intake was strongly associated with picky eating. Picky eating was also associated with an increase in the odds of having hard stools of about 30%, and this relationship was mediated by dietary fibre.⁽⁴⁰⁾ Dietary fibre intake in children who were not picky eaters was 9.1 g NSP fibre/day (about 11 g AOAC fibre/day), which is below the UK Scientific Advisory Committee on Nutrition (SACN) guideline of 15 g AOAC fibre/day for children aged 2–5 years old⁽⁶⁶⁾. The even lower intake of the picky eaters was largely a consequence of a lower intake of vegetables and fruit than the non-picky eaters. The difference between the groups in dietary fibre intake was still evident at age 13 years⁽⁵⁰⁾. The primary cause of constipation is lack of dietary fibre, and thus all children, but particularly picky eaters, would benefit from increasing their fruit and vegetable intakes and other foods rich in fibre.

Advice for health professionals and caregivers

Many children go through a period of time as a picky eater and it can be difficult for health providers to judge when intervention is needed. It has been suggested this decision should be based on whether the child's feeding behaviour is problematic for health, development, education, psychological wellbeing and socialisation⁽⁶⁷⁾. Referral to a paediatric dietician or psychologist is recommended for children who fulfil the diagnostic criteria for ARFID or

who have special dietary requirements for a chronic disease such as type 1 diabetes, a metabolic disorder or cystic fibrosis, or who have learning difficulties or autistic spectrum disorders. However, there is also a need to identify persistent picky eaters, who may need surveillance of growth and development and detailed advice on management. Many children will not present to a healthcare provider and there is also a need for more general advice for caregivers that is consistent and practical and that can be readily accessed as public health information.

Caregivers should be reassured that picky eating is a common stage of development that is unlikely to cause any permanent harm to the child's long-term development. Levene and Williams ⁽⁶⁷⁾ have set out detailed strategies for parents/caregivers and include information on sample portion sizes for preschool children, a sample plan for graded exposure to food items, and a list of resources for parents and health professionals. Key strategies described in greater detail include: (1) having realistic expectations of children's portion sizes; (2) graded and repeated exposure to unfamiliar foods (10–15 positive experiences may be needed); (3) using non-food rewards to provide motivation; (4) having a positive approach, avoiding negativity and pressure to eat; (5) parental modelling of eating fruit and vegetables and trying unfamiliar foods; (6) promoting appetite by limiting snacks and energy-providing drinks such as milk, juice and soft drinks in between meals; (7) having social food experiences such as family meals with all members eating the same food; (8) focusing on long-term goals and being consistent.

Conclusion

The identification of picky eating in children is hampered by the lack of a universally accepted definition and assessment tool. Their children's picky eating can cause stress to parents/caregivers and may have a negative impact on family relationships, and so it is important that health providers are able to identify picky eating confidently and provide caregivers with appropriate advice. For most children, the behaviour seems to resolve spontaneously, perhaps because the child is exposed to a wider range of foods through gradually being more socially active at pre-school, toddler group, school and getting to know a wider range of peers with growing independence and autonomy. The evidence for an impact of being a picky eater on health and development is mostly limited to studies on growth, but these are generally reassuring. However, there may be a subsample of picky

eaters in whom the behaviour does become embedded and they may be at risk of being thin during adolescence or may emerge later with an eating disorder or as an adult picky eater. Identification, support and parental advice at an early age in this small group of children is very important to be able to avert these more serious outcomes.

Funding

CMT was supported by a Wellcome Trust Career Re-Entry Fellowship (Grant ref: 104077/Z/14/Z).

Conflict of interest

PME has from time to time received research funding and consultancy funding from Pfizer Nutrition Ltd, Danone Baby Nutrition (Nutricia Ltd) and Nestle Nutrition. CMT has received research funding from Nestle Nutrition.

Authorship

CMT wrote the manuscript and PME critically revised it. Both authors have read and approved the final version.

Table 1 Effect of picky eating on intakes of nutrients, foods and food groups and comparison with recommended daily allowances: data from the UK ALSPAC study

Authors/aim	Aim	Age of dietary assessment (years)	n	Dietary assessment tool	Nutrients	Comparison with recommended intakes	Foods and food groups
Taylor <i>et al.</i> (22)	Investigate macro- and micronutrient intakes in PE and non-PE	3.5 ^a	PE: 131 Non-PE: 364 PE assessed cross-sectionally at 3 years	3-day food record ^b	PE had lower intakes of protein, carotene, Fe, Zn and Se than non-PE No differences in energy intakes between groups	Energy intakes were adequate in terms of EAR Fe and Zn intakes were more likely to be below RNI in PE than non-PE Free sugar was much higher than recommended in both groups	PE consumed less meat, fish, vegetables and fruits than non-PE
Taylor <i>et al.</i> (22)	Investigate macro- and micronutrient intakes in PE and non-PE according to persistence and timing of onset	7.5 ^c	Persistent-PE: 403 Non-persistent-PE: 279 Late-onset-PE: 100 Non-PE: 1350 PE assessed longitudinally PE: 1400 Non-PE: 4307 PE assessed cross-sectionally at 3 years	3-day food record ^b	Intakes of protein, carotene, vitamin D, Fe, Zn and Se were all highest in non-PE and lowest in late-onset-PE and persistent-PE (3–16% lower). Free sugars were lowest in non-PE and highest in persistent-PE and late-onset-PE Non-persistent-PE were intermediate Energy intakes were not different	Energy intakes were adequate in terms of EAR Retinol equivalents, iron and zinc were most likely to be below RNI and LRNI for persistent-PE and late onset-PE than non-PE Free sugars were much higher than recommended in all groups	Persistent and late-onset-PE consumed less meat, vegetables and fruits than non-PE Persistent-PE consumed the most sweet biscuits and confectionery
Taylor <i>et al.</i> (40)	Investigate association of dietary fibre intakes and stool hardness with picky eating	3	PE: 1400 Non-PE: 4307 PE assessed cross-sectionally at 3 years	FFQ	Dietary fibre intake lower in PE than in non-PE 12.5% of variation in fibre intake explained by PE score	Dietary fibre intake in both PE and non-PE below recommended level	PE had a 6.8% lower percentage of fibre from vegetables than non-PE
Taylor and Emmett (50)	Investigate diet at 10 and 13 years in children identified as PE at age 3 years	10 and 13	PE: 804, 693 Non-PE: 2341, 1981 PE assessed cross-sectionally at 3 years	3-day food record	Lower intakes of protein, carotene, vitamin D, Se, Zn and dietary fibre; higher intakes of free sugars in PE vs non-PE at 10 years old. Difference less evident at 13 years except for higher free sugars and lower Zn intakes in PE than non-PE.	PE more likely than non-PE to be below LRNI for Zn at both 10 and 13 years Free sugars were much higher than recommended in all groups	Lower intakes of meat, fish, fruit and vegetables for PE vs non-PE at 10 years Similar difference persisted at 13 years

EAR, estimated average requirement; FFQ, food frequency questionnaire; LRNI, lower reference nutrient intake; PE, picky eater.

^aPicky eating identified by single question at 3 years old: Does your child have definite likes and dislikes as far as food is concerned? (No/Yes, quite choosy/Yes, very choosy).

^bSimilar results obtained from FFQ at 4 years

^cPicky eating identified longitudinally as ‘never’/‘low’/‘early onset’ (persistent or not persistent)/‘late onset’ at 2–5.5 years old (for details see Taylor *et al.* (22)).

References

1. Goh DY, Jacob A (2012) Perception of picky eating among children in Singapore and its impact on caregivers: a questionnaire survey. *Asia Pac Fam Med* **11**, 5.
2. Taylor CM, Wernimont S, Northstone K *et al.* (2015) Picky/fussy eating in children: a review of definitions and assessment measures, and prevalence in a UK longitudinal cohort. *Appetite* **95**, 349-359.
3. Dovey TM, Staples PA, Gibson EL *et al.* (2008) Food neophobia and 'picky/fussy' eating in children: a review. *Appetite* **50**, 181-193.
4. University of Bristol (2018) Avon Longitudinal Study of Parents and Children. <http://www.bristol.ac.uk/alspac/> (accessed 1 August 2018)
5. Mascola AJ, Bryson SW, Agras WS (2010) Picky eating during childhood: a longitudinal study to age 11 years. *Eating behaviors* **11**, 253-257.
6. Ekstein S, Laniado D, Glick B (2010) Does picky eating affect weight-for-length measurements in young children? *Clinical pediatrics* **49**, 217-220.
7. Hafstad GS, Abebe DS, Torgersen L *et al.* (2013) Picky eating in preschool children: the predictive role of the child's temperament and mother's negative affectivity. *Eating behaviors* **14**, 274-277.
8. van der Horst K (2012) Overcoming picky eating. Eating enjoyment as a central aspect of children's eating behaviors. *Appetite* **58**, 567-574.
9. van der Horst K, Eldridge A, Deming D *et al.* (2014) Caregivers' perceptions about picky eating: associations with texture acceptance and food intake (379.3). *The FASEB Journal* **28**.
10. Zimmerman J, Fisher M (2017) Avoidant/Restrictive Food Intake Disorder (ARFID). *Current problems in pediatric and adolescent health care* **47**, 95-103.
11. Hendy HM, Williams KE, Riegel K *et al.* (2010) Parent mealtime actions that mediate associations between children's fussy-eating and their weight and diet. *Appetite* **54**, 191-195.
12. Morrison H, Power TG, Nicklas T *et al.* (2013) Exploring the effects of maternal eating patterns on maternal feeding and child eating. *Appetite* **63**, 77-83.
13. Tharner A, Jansen PW, Kiefte-de Jong JC *et al.* (2015) Bidirectional associations between fussy eating and functional constipation in preschool children. *The Journal of pediatrics* **166**, 91-96.e91.
14. van der Horst K, Deming DM, Lesniasukas R *et al.* (2016) Picky eating: Associations with child eating characteristics and food intake. *Appetite* **103**, 286-293.
15. Orun E, Erdil Z, Cetinkaya S *et al.* (2012) Problematic eating behaviour in Turkish children aged 12-72 months: characteristics of mothers and children. *Central European journal of public health* **20**, 257-261.
16. Cardona Cano S, Tiemeier H, Van Hoeken D *et al.* (2015) Trajectories of picky eating during childhood: A general population study. *International Journal of Eating Disorders* **48**, 570-579.
17. Dubois L, Farmer AP, Girard M *et al.* (2007) Preschool children's eating behaviours are related to dietary adequacy and body weight. *European journal of clinical nutrition* **61**, 846-855.
18. Marchi M, Cohen P (1990) Early childhood eating behaviors and adolescent eating disorders. *Journal of the American Academy of Child and Adolescent Psychiatry* **29**, 112-117.
19. Steinsbekk S, Bonneville-Roussy A, Fildes A *et al.* (2017) Child and parent predictors of picky eating from preschool to school age. *The international journal of behavioral nutrition and physical activity* **14**, 87.

20. Dubois L, Farmer A, Girard M *et al.* (2007) Problem eating behaviors related to social factors and body weight in preschool children: A longitudinal study. *The international journal of behavioral nutrition and physical activity* **4**, 9.
21. Cardona Cano S, Hoek HW, van Hoeken D *et al.* (2016) Behavioral outcomes of picky eating in childhood: a prospective study in the general population. *Journal of child psychology and psychiatry, and allied disciplines* **57**, 1239-1246.
22. Taylor CM, Northstone K, Wernimont SM *et al.* (2016) Macro- and micronutrient intakes in picky eaters: a cause for concern. *The American journal of clinical nutrition* **104**, 1647-1656.
23. Moroshko I, Brennan L (2013) Maternal controlling feeding behaviours and child eating in preschool-aged children. *Nutrition & Dietetics* **70**, 49-53.
24. Cooke LJ, Haworth CM, Wardle J (2007) Genetic and environmental influences on children's food neophobia. *The American journal of clinical nutrition* **86**, 428-433.
25. Bell KI, Tepper BJ (2006) Short-term vegetable intake by young children classified by 6-n-propylthiouracil bitter-taste phenotype. *The American journal of clinical nutrition* **84**, 245-251.
26. de Barse LM, Jansen PW, Edelson-Fries LR *et al.* (2017) Infant feeding and child fussy eating: The Generation R Study. *Appetite* **114**, 374-381.
27. Jacobi C, Agras WS, Bryson S *et al.* (2003) Behavioral validation, precursors, and concomitants of picky eating in childhood. *Journal of the American Academy of Child and Adolescent Psychiatry* **42**, 76-84.
28. Galloway AT, Lee Y, Birch LL (2003) Predictors and consequences of food neophobia and pickiness in young girls. *J Am Diet Assoc* **103**, 692-698.
29. Shim JE, Kim J, Mathai RA *et al.* (2011) Associations of infant feeding practices and picky eating behaviors of preschool children. *J Am Diet Assoc* **111**, 1363-1368.
30. Finistrella V, Manco M, Ferrara A *et al.* (2012) Cross-sectional exploration of maternal reports of food neophobia and pickiness in preschooler-mother dyads. *Journal of the American College of Nutrition* **31**, 152-159.
31. Gregory JE, Paxton SJ, Brozovic AM (2011) Maternal feeding practices predict fruit and vegetable consumption in young children. Results of a 12-month longitudinal study. *Appetite* **57**, 167-172.
32. Gregory JE, Paxton SJ, Brozovic AM (2010) Maternal feeding practices, child eating behaviour and body mass index in preschool-aged children: a prospective analysis. *The international journal of behavioral nutrition and physical activity* **7**, 55.
33. Gregory JE, Paxton SJ, Brozovic AM (2010) Pressure to eat and restriction are associated with child eating behaviours and maternal concern about child weight, but not child body mass index, in 2- to 4-year-old children. *Appetite* **54**, 550-556.
34. Jansen PW, de Barse LM, Jaddoe VWV *et al.* (2017) Bi-directional associations between child fussy eating and parents' pressure to eat: Who influences whom? *Physiology & behavior* **176**, 101-106.
35. Galloway AT, Fiorito L, Lee Y *et al.* (2005) Parental pressure, dietary patterns, and weight status among girls who are "picky eaters". *J Am Diet Assoc* **105**, 541-548.
36. de Barse LM, Cardona Cano S, Jansen PW *et al.* (2016) Are parents' anxiety and depression related to child fussy eating? *Arch Dis Child* **101**, 533-538.
37. Emmett PM, Hays NP, Taylor CM (2018) Antecedents of picky eating behaviour in young children. *Appetite*. doi 10.1016/j.appet.2018.07.032

38. Berger PK, Hohman EE, Marini ME *et al.* (2016) Girls' picky eating in childhood is associated with normal weight status from ages 5 to 15 y. *The American journal of clinical nutrition* **104**, 1577-1582.
39. Brown CL, Perrin EM, Peterson KE *et al.* (2017) Association of picky eating with weight status and dietary quality among low-income preschoolers. *Acad Pediatr* doi 10.1016/j.acap.2017.08.014
40. Taylor CM, Northstone K, Wernimont SM *et al.* (2016) Picky eating in preschool children: Associations with dietary fibre intakes and stool hardness. *Appetite* **100**, 263-271.
41. Tharner A, Jansen PW, Kiefte-de Jong JC *et al.* (2014) Toward an operative diagnosis of fussy/picky eating: a latent profile approach in a population-based cohort. *Int J Behav Nutr Phy* **11**, 14.
42. Rohde JF, Handel MN, Stougaard M *et al.* (2017) Relationship between pickiness and subsequent development in body mass index and diet intake in obesity prone normal weight preschool children. *PLoS one* **12**, e0172772.
43. Carruth BR, Ziegler PJ, Gordon A *et al.* (2004) Prevalence of picky eaters among infants and toddlers and their caregivers' decisions about offering a new food. *J Am Diet Assoc* **104**, s57-64.
44. Antoniou EE, Roefs A, Kremers SP *et al.* (2016) Picky eating and child weight status development: a longitudinal study. *Journal of human nutrition and dietetics : the official journal of the British Dietetic Association* **29**, 298-307.
45. Carruth BR, Skinner J, Houck K *et al.* (1998) The phenomenon of "picky eater": a behavioral marker in eating patterns of toddlers. *Journal of the American College of Nutrition* **17**, 180-186.
46. Carruth BR, Skinner JD (2000) Revisiting the picky eater phenomenon: neophobic behaviors of young children. *Journal of the American College of Nutrition* **19**, 771-780.
47. Emmett PM, Jones LR (2015) Diet, growth, and obesity development throughout childhood in the Avon Longitudinal Study of Parents and Children. *Nutrition reviews* **73 Suppl 3**, 175-206.
48. Xue Y, Zhao A, Cai L *et al.* (2015) Growth and development in chinese pre-schoolers with picky eating behaviour: a cross-sectional study. *PLoS one* **10**, e0123664.
49. Volger S, Sheng X, Tong LM *et al.* (2017) Nutrient intake and dietary patterns in children 2.5-5 years of age with picky eating behaviours and low weight-for-height. *Asia Pac J Clin Nutr* **26**, 104-109.
50. Taylor CM, Emmett P (2017) Diet at 10 and 13 years in children identified as picky eaters at age 3 years in a longitudinal birth cohort study. *Proceedings of the Nutrition Society* **76**, E121.
51. Byrne R, Jansen E, Daniels L (2017) Perceived fussy eating in Australian children at 14 months of age and subsequent use of maternal feeding practices at 2 years. *Int J Behav Nutr Phy* **14**, 123.
52. Taylor CM, Steer CD, Hays NP *et al.* (2018) Growth and body composition in children who are picky eaters: a longitudinal view. *European journal of clinical nutrition* doi 10.1038/s41430-018-0250-7
53. Viana V, Sinde S, Saxton JC (2008) Children's Eating Behaviour Questionnaire: associations with BMI in Portuguese children. *The British journal of nutrition* **100**, 445-450.
54. Sleddens EF, Kremers SP, Thijs C (2008) The children's eating behaviour questionnaire: factorial validity and association with Body Mass Index in Dutch children aged 6-7. *The international journal of behavioral nutrition and physical activity* **5**, 49.
55. Webber L, Hill C, Saxton J *et al.* (2009) Eating behaviour and weight in children. *International Journal of Obesity (Lond)* **33**, 21-28.
56. de Barse LM, Tiemeier H, Leermakers ET *et al.* (2015) Longitudinal association between preschool fussy eating and body composition at 6 years of age: The Generation R Study. *The international journal of behavioral nutrition and physical activity* **12**, 153.

57. Kotler LA, Cohen P, Davies M *et al.* (2001) Longitudinal Relationships Between Childhood, Adolescent, and Adult Eating Disorders. *Journal of the American Academy of Child & Adolescent Psychiatry* **40**, 1434-1440.
58. Micali N (2005) Childhood risk factors: Longitudinal continuities and eating disorders. *Journal of Mental Health* **14**, 567-574.
59. Thompson C, Cummins S, Brown T *et al.* (2015) What does it mean to be a 'picky eater'? A qualitative study of food related identities and practices. *Appetite* **84**, 235-239.
60. Ellis JM, Schenk RR, Galloway AT *et al.* (2018) A multidimensional approach to understanding the potential risk factors and covariates of adult picky eating. *Appetite* **125**, 1-9.
61. Jacobi C, Schmitz G, Agras WS (2008) Is picky eating an eating disorder? *The International journal of eating disorders* **41**, 626-634.
62. Auth MK, Vora R, Farrelly P *et al.* (2012) Childhood constipation. *Bmj* **345**, e7309.
63. Mugie SM, Di Lorenzo C, Benninga MA (2011) Constipation in childhood. *Nat Rev Gastroenterol Hepatol* **8**, 502-511.
64. Chao HC (2018) Association of Picky Eating with Growth, Nutritional Status, Development, Physical Activity, and Health in Preschool Children. *Front Pediatr* **6**, 22.
65. Xue Y, Lee E, Ning K *et al.* (2015) Prevalence of picky eating behaviour in Chinese school-age children and associations with anthropometric parameters and intelligence quotient. A cross-sectional study. *Appetite* **91**, 248-255.
66. Scientific Advisory Committee on Nutrition (2015) Carbohydrates and health. Norwich: TSO.
67. Levene IR, Williams A (2018) Fifteen-minute consultation: The healthy child: 'My child is a fussy eater!'. *Arch Dis Child Educ Pract Ed* **2013**, 71-77.