

REVIEW ARTICLE

Factors associated with the early emergence of atypical feeding behaviours in infants and young children: A scoping review

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Abstract

Background: Atypical feeding behaviours such as significantly limited food preferences, hypersensitivity to food textures or temperatures and pocketing food without swallowing are common concerns in child health. Current reports indicate an inter-relationship between early growth, feeding problems and developmental disorders, yet little is known about how these behaviours develop in early childhood. There is also a lack of consensus about clinical definitions for atypical feeding behaviours, diagnostic thresholds and the associated precursors. To date, there has been no synthesis of the extant literature about factors associated with the early onset of atypical feeding behaviours in young children.

Objective: This scoping review aimed to characterize the factors associated with the early emergence of atypical feeding behaviours in typically developing young children.

Methods: CINAHL, MEDLINE, PsycINFO and Scopus databases were searched. Studies published in the last 5 years were included if they examined factors associated with the development of atypical eating behaviours in infants and young children. Of the 2137 records obtained after the search strategy was applied, 202 full-text articles were retrieved for a more detailed examination and to ensure they met the inclusion criteria. This resulted in 54 studies being included in this scoping review.

Results: Of the 54 studies, three studies analysed precursors responsible for atypical feeding behaviours, and 51 studies discussed the factors associated with the early emergence of feeding difficulties. Multiple factors, including genetic factors, breastfeeding, late introduction of solids and lumpy foods, complementary feeding techniques, parental mental health, prematurity and child factors including temperament, were identified. There is inconsistent evidence for the associations between breastfeeding exposure and feeding difficulties.

Conclusions: This study identified multiple factors potentially associated with the early onset of atypical feeding behaviours in young children; however, there is

insufficient evidence at this time to support specific recommendations for early feeding practices in young children. More methodologically rigorous studies are needed to extend these findings.

KEYWORDS

early-onset, feeding, feeding behaviours, feeding difficulties, infancy, review, young children

1 | INTRODUCTION

Atypical feeding behaviours among children are a common concern occurring in 20–50% of typically developing children and 70–89% of children with developmental disabilities (Benjasuwantep et al., 2013). Variance in the prevalence rate is attributed to discrepancies in the assessment methods used and to definition issues (Benjasuwantep et al., 2013). Despite their prevalence, little is known about how these behaviours develop in early childhood. Feeding problems can be multi-dimensional and impact oral-motor and sensory skills, dietary and nutritional requirements and carer-child interaction. Feeding difficulties can manifest as significantly limited food preferences, hypersensitivity to food textures or temperatures and pocketing food without swallowing (Mayes & Zickgraf, 2019). Also, feeding has a strong relational dimension between the child and the parent; it can be an enjoyable activity for both or cause stress (Baraskewich et al., 2021). Moreover, there is an intriguing inter-relationship between growth, feeding problems and developmental disorders, yet to be explored systematically (Keen, 2008). Assessing and managing feeding difficulties can be complicated and frustrating for health professionals and parents due to its variable progression (Baraskewich et al., 2021).

Picky eating, food neophobia, difficulties related to swallowing, delayed oral-motor skills and pain or discomfort during feeding are categorized as feeding difficulties. Picky eating and food neophobia are the most common atypical feeding behaviours in early childhood (Wolstenholme et al., 2020). One of the barriers to understanding feeding difficulties is the lack of consistency in the terminology used; Baraskewich et al. (2021) proposed that the term 'eating difficulties' should be used when behaviours involve a pre-occupation with food, eating or body image and the word 'feeding difficulties' should be used when such obsession is absent. Avoidant Restrictive Food Intake Disorder (ARFID) resembles a persistent and extreme version of picky eating and is included in the DSM-5⁶ (Keren, 2016) replacing the feeding disorder of infancy and early childhood.

There is a plethora of research on feeding difficulties and intervention for autistic children and those with other neuropsychiatric disorders (Baraskewich et al., 2021). Despite the prevalence and impact of feeding difficulties in childhood, there has been no research synthesis on the factors associated with the early onset of atypical feeding behaviours in young children. Early identification of these factors is essential due to the related caregiver stress and their relationship to neurodevelopmental conditions (Sdravou et al., 2021). Also, as

Key messages

- There is inconsistent evidence for associations between breastfeeding exposure and feeding difficulties in early childhood.
- Age of introduction of solid foods and early introduction of textures play an important role in increased food acceptance in young children.
- Lack of consistent operational definition for feeding difficulties poses challenges with assessment and management.
- The role of child temperament in feeding practices and eating behaviours requires further exploration.
- Methodologically rigorous studies are needed to identify the impact of factors such as duration of breastfeeding, introduction of solid foods, sensory preferences and complementary feeding techniques such as baby-led weaning versus traditional spoon feeding on atypical feeding behaviours.

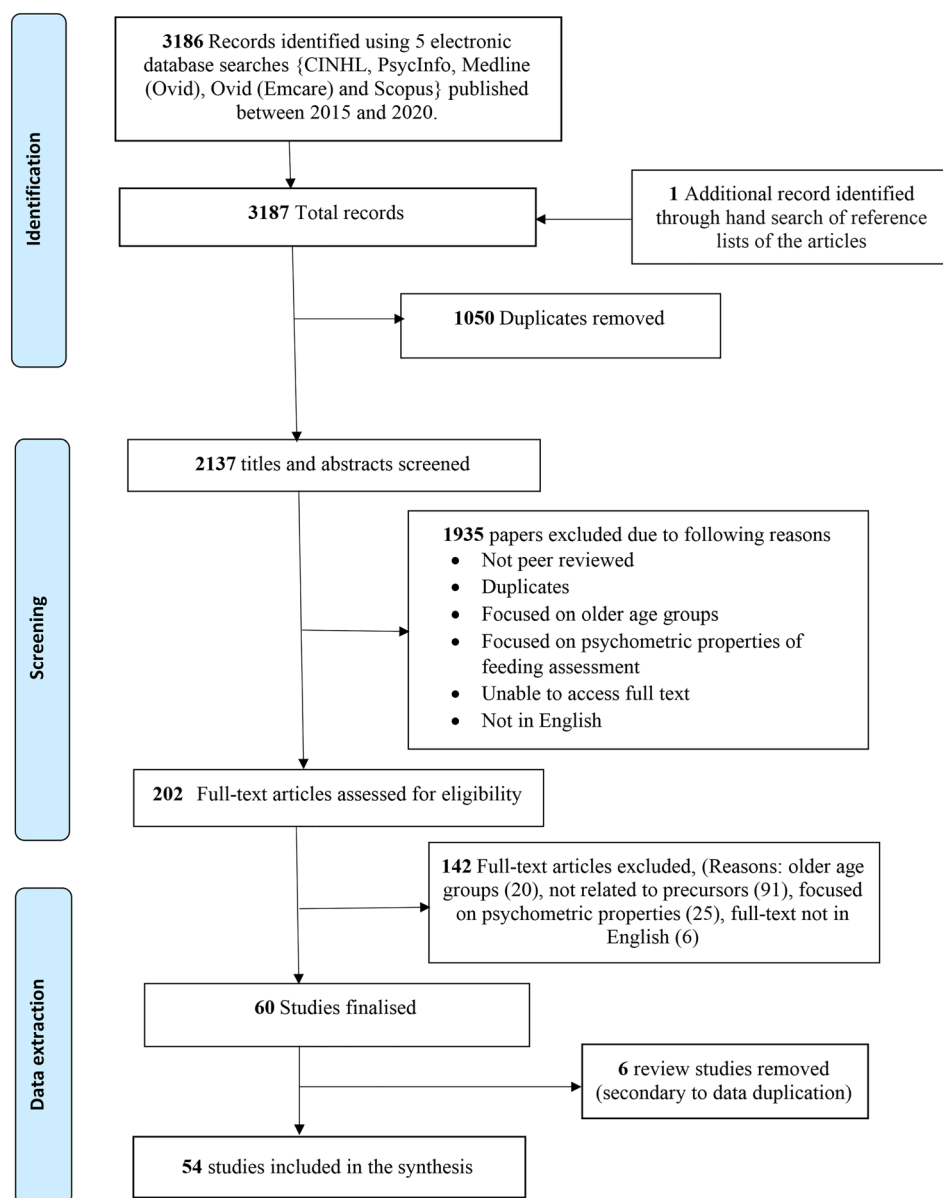
the first 2 years of life are critical to the development of healthy eating habits which continue into later life (Nicklaus, 2016), it is crucial to understand the relevant factors responsible for atypical feeding behaviours in young children. Delays in early intervention may result in simple feeding problems becoming pervasive or resistant to treatment and increase the risk of malnutrition, growth difficulties, childhood obesity and developmental and cognitive delays (Sharp et al., 2013).

Therefore, this scoping review aims to elucidate factors associated with the emergence of atypical feeding behaviours in typically developing young children.

2 | METHODS

A scoping review was conducted following the approach recommended by Arksey and O'Malley (2005). The Cochrane Collaboration and the Centre for Reviews and Dissemination (Cumpston et al., 2019) and the Preferred Reporting Items for Systematic reviews and Meta-Analysis extension for Scoping Reviews (PRISMA-ScR; McGowan et al., 2020) guidelines were adopted for reporting

FIGURE 1 Flow diagram of the literature search process



purposes (Figure 1). A scoping review was chosen given that there are many studies examining feeding difficulties in young children, but a synthesis of these findings has yet to be published to the best of the author's knowledge.

This scoping review is registered on the Open Science Framework registry (GUID No yhf6g).

2.1 | Identifying the research question

This scoping review aimed to map the existing evidence base for factors associated with the early onset of atypical feeding behaviours in typically developing young children.

The research question guiding this scoping review was: What factors are associated with the early emergence of atypical feeding behaviours in typically developing young children?

2.2 | Identifying relevant studies

To glean a 'broad coverage' of available literature, a comprehensive definition of keywords for search terms was adopted (Arksey & O'Malley, 2005). These searches used a combination of key terms (Table 1) and were adjusted to suit each database. A university librarian was consulted to refine the key search terms and identify relevant databases. A hand search of reference lists of the articles was completed to determine any missed references. The review of the literature was conducted over 4 months, ending in October 2020.

2.3 | Study selection

A systematic search of the databases returned 3,186 articles, with a further one article found through hand searching. All citations were

TABLE 1 Keywords used in database search

Concept 1	Concept 2	Concept 3
Atypical feed* OR atypical eat* OR picky eat* OR fussy eat* OR faddy eat* OR eating habit* OR eating behavi*early emergence and (eat* or feed* or food)	Precursor and (eat* or feed* or food) OR predictors and (eat* or feed* or food*) OR limited appetite OR Bottlefeed* OR breastfeed* OR formula feed* OR failure to thrive OR fear of feeding OR new foods OR prolonged mealtime* OR prematur* OR food choice* OR solid intro* OR selective eat* OR food preference OR over eat* OR food select* OR food hoard* OR under eat* OR low birth weight OR food pouch* OR food pocket* OR chok* and (eat* or feed* or food) OR gag* and (eat* or feed* or food) OR sensory and (eat* or feed* or food) OR oral motor and (eat* or feed* or food) OR food aversion OR family mealtime behavi* OR food refus* OR stressful mealtime* OR child nutrition OR food neophobia OR food jag* OR Pica OR rumination syndrome	Infant* OR newborn* OR neonate* OR baby OR toddler* OR young child* OR preschool*)

exported to EndNote™ and then to Covidence™ for review. After duplicates (n = 1,050) were removed, the first author and a second reviewer independently conducted a comprehensive screening of 1) the study titles and abstracts (n = 2,137) and 2) full-text articles (n = 202) with guidance from the inclusion criteria (Table 2). Following this process, 60 studies were retained as meeting the inclusion criteria. Out of these 60 studies, six review studies were removed to avoid duplication of data from other studies already included resulting in 54 studies included in the review (Figure 1).

2.4 | Data charting, collation and summarizing

The descriptive-analytical method outlined by Arksey and O'Malley (2005) was used to evaluate each article and chart key relevant information. Based on the study design, the results were organized into two categories, precursors of atypical feeding behaviours and factors associated with atypical feeding behaviours. To facilitate analysis and reporting, data were extracted following the Covidence™ data extraction guide. Data extracted included study design, study setting and population, study outcomes and information necessary to assess the risk of bias.

2.5 | Risk-of-bias assessment

Although quality assessment is not a priority in scoping reviews (Pham et al., 2014), the quality of the included primary studies was appraised using the Mixed Method Appraisal Tool (MMAT)—version 2018 (Hong et al., 2019). The MMAT has established content validity and piloted across all methodologies (Pace et al., 2012; Souto et al., 2015).

The first author performed the critical appraisal of all included studies. No study was excluded based on quality assessment. Relevant

TABLE 2 PICOS criteria for inclusion of studies

Inclusion criteria	
Population	Young children (0–6 years) representing the general population
Intervention/ exposure/ comparator	Precursors and/or factors associated with atypical feeding behaviours in young children: • Genetic factors • Breastfeeding • Introduction of complementary foods • Sensory preferences • Parental feeding practices • Parents mental health • Feeding techniques • Prematurity
Outcomes	Atypical feeding behaviours
Study design	Reviews, observational and experimental studies. Peer reviews and academic journals published between 2015 and 2020 and in English language.

sections of the MMAT were used for quality assessment based on study design. Specifically, qualitative studies were assessed using Section 1; randomized controlled trials using Section 2; non-randomized trials using Section 3 and descriptive studies using Section 4. Where a mixed methods design was adopted, Section 1 was used to assess the qualitative components, and one of Sections 2 to 5 was used to assess the quantitative components dependent on study design.

The overall quality for each of the studies selected was calculated following the MMAT guidelines (score = number of criteria met/4) and then presented using the following descriptors: low

quality (1–25%), where minimal criteria are met; average (26–50%), above average (51–75%), and high quality (76–100%), where most criteria are met. The scores are the number of criteria met divided by four (scores varying from 25%—one criterion met—to 100%—all criteria met). For mixed methods studies, the principle is that the overall quality of a combination cannot be more than the quality of its weakest component (Hong et al., 2019).

3 | RESULTS

Table 3 reports the findings of studies examining precursors of atypical feeding behaviours in young children. These studies were either

longitudinal or Randomised Control Trial (RCT) designs. Table 4 reports the findings examining factors associated with atypical feeding behaviours in young children. These studies were longitudinal, RCT, review, cross-sectional or cohort designs.

3.1 | Study design

Of the 54 studies included in the synthesis, four utilized an RCT design (da Costa et al., 2017; Mallan et al., 2016; Sanchez et al., 2018; Tauman et al., 2017) and eight were reviews (Dunn & Lessen, 2017; Gibson & Cooke, 2017; Nicklaus, 2016; Taylor & Emmett, 2019; Verhage et al., 2018; Walton et al., 2017; Watson et al., 2018;

TABLE 3 Studies exploring precursors for atypical feeding behaviours

Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Mallan et al. (2016)	RCT	N = 340 mothers and children country: Australia	Anthropometry, CEBQ, Childrens dietary questionnaire	- Having tried increased number of fruits & vegetables at 14 months predicted food preferences & higher intakes at 3.7 years - Adjusting for and trying more vegetables FF at 14 months was associated with lower FF at 3.7 years	Above average
Micali et al. (2016)	Longitudinal prospective study	N = 1,326 5–7-year-old children, country: UK	Parent interview on childhood eating behaviours	- Feeding problems in infancy were prospectively associated with childhood picky eating and emotional undereating. - A high thriving index in infancy was inversely associated with both picky and poor eating. - Feeding problems and poor growth in the first year of life showed high continuity into childhood restrictive eating.	Above Average
Steinsbekk et al. (2017)	Longitudinal study	N = 1,250 4-year-old children and their parents, country: Norway	The preschool age psychiatric assessment for pickiness & sensory sensitivity, Norwegian version of CEBQ for negative affectivity, videotaped parent/child interactions	- Pickiness was moderately stable from preschool to school age. - Children who are more sensory sensitive at age 4 are at higher risk for pickiness two years later. - Children with high levels of sensory sensitivity and had parents with high sensitivity and low on structuring were most likely to display more pickiness over time. - Individual differences in temperament did not predict pickiness and there were no gender differences in the prediction of pickiness.	Above average

TABLE 4 Characteristics of studies exploring patterns & associations for atypical feeding behaviours

Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Amarger et al. (2015)	Cohort study	N = 217 (including 38 pairs of twins), age: Pre-term - 2 years (corrected), country: UK	Eating behaviour was assessed at 2 years of age (corrected) using the children eating difficulties questionnaire. Genomic DNA was extracted from buccal swabs using the nucleospin tissue DNA extraction kit.	- Eating behaviour was strongly correlated in monozygotic ($r = 0.92$, $p = 0.0001$) but not dizygotic twins ($r = 0.27$, $p = 0.14$), suggesting a strong heritability of this trait. - One SNP (rs11671975) in the insulin receptor (INSR) gene was significantly associated with eating behaviour.	Above average
Bell et al. (2018)	Cross sectional	N = 206 parents of children between 1 to 5 years Country: Australia	Child food neophobia scale, pre-schooler & toddler dietary questionnaire	- Shorter BF duration ($\beta = -0.21$; $p = 0.0001$) and poorer child food neophobia scores ($\beta = 0.36$; $p < 0.0001$) were associated with higher dietary risk scores. - Age of introduction to solids showed no association with dietary risk ($p = 0.744$).	Average
Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Bligin and Wolke (2017)	Longitudinal study	N = 178 (73 VP/VLBW infants & 105 FT infants) Country: UK	Maternal sensitivity using BChAPS, mother-infant structured play assessment, interviews	- Feeding problems were associated with maternal sensitivity at 18 months and 3 years in VP/VLBW. - Feeding problems and maternal sensitivity had reciprocal relationship at 18 months and 3 years for FT infants.	High
Boots et al. (2019)	Prospective longitudinal study	N = 106 mother & child dyads Country: Australia	Parent survey, CFQ, covert control scale, individual child interviews for food preferences, weight & height of children	- Greater use of parental restrictive feeding was associated with decreased preferences for fruits and vegetables. - Covert feeding was associated with increased preferences for fruits and vegetables two years later. - No evidence that either parental feeding strategy influenced change in childrens weight.	Above average
Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Cardona Cano et al. (2015)	Cohort study	N = 4,018, age: Pregnancy to 6 years Country: UK	Picky eating was assessed at ages 1.5, 3, and 6 by using the Dutch CBCL. Dietary intake was assessed with the FFQ at 14 months. Eating behaviour was assessed with the Dutch version of the CEBQ when the children were 4 years old.	- Picky eating was found to be very common in preschool-age children. Prevalence of picky eating was highest at 3 years of age (27.6%) and lowest at 6 years of age (13.2%). - Almost two-thirds of the early picky eaters remitted within 3 years. Male sex, lower birth weight, non-Western maternal ethnicity, and low parental income predicted persistent picky eating. - More often late-onset picky eaters were children of parents with low income and non-Western ethnicity. First born were more often remitting picky eaters.	Average
Cole, Wang, et al. (2017)	Cohort study	N = 153, age: Parents of 2-5-year-old non-Hispanic white pre-schoolers, country: USA	Anthropometric measures, genotyping & DNA extraction	- An association was observed between picky eating behaviour and genetic variants in TAS2R38 (taste receptor 2 member 38) and CA6(carbonic anhydrase VI, or gustin). - The TAS2R38 -rs713598 SNP was associated with limited dietary variety, and the CA6 -rs2274327 SNP was	Above average

TABLE 4 (Continued)

Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Cole et al. (2018)	Cohort study	N = 497, age: Parents of pre-school children, country: USA	CEBI, family ritual questionnaire, CFPQ	- Child control over feeding and watching television during mealtime were associated with higher odds of picky eating behaviour. - Family meals and structured mealtime routine was associated with lower odds of picky eating behaviour 1 year later	Above average
Costantini et al. (2019)	Longitudinal study	N = 46 Mother-infant dyads Country: Europe	Interviews, video-recorded mealtimes	- Most infants being introduced to CF before 6 months of age, despite advice to mothers. - Early introduction or late onset of CF had no effect - On infant willingness to eat. - Food textures accepted by infants. - Infant BMI	Average
Coulthard and Sahota (2016)	Cross-sectional	N = 63 parent child pairs, country: UK	Adolescent/adult SP, SP (children), food Neophobia scale, CFNS, tactile play task,	- Parental neophobia & enjoyment of tactile play were strongly related to child food neophobia. - Strong association between tactile sensitivity, food neophobia, & tactile play had associations between the scores of children & their parents.	Average
Reference	Study design	Study setting and population	Outcome measure	Results	Quality
da Costa et al. (2017)	RCT	N = 28 (8-month-old infants) country: Netherlands	Video recording, OLSF, MOE	After the 4-week exposure period, the group that had been exposed to the foods with more, larger and harder pieces showed a significantly higher rating for chewing a piece of carrot and potato for the first time.	High
de Barse et al. (2016)	Cohort study	N = 4,746 age: 4-year-old children & their parents, country: Netherlands	BSI for assessing parents depression & anxiety, CEBQ	- Maternal anxiety during pregnancy and during the child's preschool period was related to higher food fussiness scores in children. - Mothers depressive symptoms at both time points were associated with fussy eating behaviour in their children. - Similar associations were found between fathers internalizing problems and children's fussy eating. However, fathers anxiety during the antenatal period was not related to child fussy eating.	High
de Barse et al. (2017)	Cohort study	N = 4,779, age: Parents of preschool children, country: Netherlands	Self-reported questionnaires for BF and timing of CF, CEBQ	- Children who were never BF did not differ in fussy eating frequency from children BF for 6 months or longer. - Children who were BF for less than 2 months had a 0.70 points higher food fussiness score than children BF for 6 months or longer. - Early introduction of vegetables at 4–5 months was associated with less fussy eating behaviour. - BF does not predict fussy eating. However, introducing vegetables into a child's diet before 5 months might be protective against fussy eating.	Average
Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Dunn and Lessen (2017)	Review	N = 15	N/A	Prenatal and postnatal periods are influential in the development of flavour and food preferences. Mothers should be encouraged to eat a healthy and varied diet when pregnant and to breastfeed their infants while continuing to eat the very same food.	High

(Continues)

TABLE 4 (Continued)

Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Emmett et al. (2018)	Cohort study	N = 5,758 age: Pregnant parents and 1- and 2-year-old children, country: UK	FFQ, crown-crisp anxiety subscale	- When a healthy eating pattern is part of the BF mothers diet, this will have a positive influence on her child's flavour and food acceptance while serving as a potentially important determinant in reducing the risk of chronic disease. - Feeding difficulties during complementary feeding and late introduction of lumpy foods (after 9 months) were associated with increased likelihood of the child being very picky. - A strong predictor was the child being choosy at 15 months, particularly if the mother was worried about this behaviour. - Providing fresh fruit and eating the same meal as the child were protective against later picky eating while feeding ready-prepared food was predictive.	Above average
Fildes et al. (2016)	Cohort study	N = 1,330 twin pairs age: Parents of 3-year-old twins country: UK	CEBQ, food fussiness scale	- Genetic correlations were significant in size between FF and liking for both vegetables (20.65) and fruit (20.43), which indicated that a substantial proportion of the genes that influence FF also influence liking. - Common genes that underlie and liking for vegetables and fruit largely explained the observed phenotypic correlations between them (68–70%)	Above average
Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Finnane et al. (2017)	Cross sectional online survey design	N = 413 of 1–10-year-old children Country: Australia	FPSQ:28, CEBQ	- Feeding practices accounted for 28% and 21% of the variance in food fussiness and enjoyment of food, respectively ($p < .001$) - More structure and less non-responsive practices were associated with lower food fussiness and higher enjoyment of food.	Above average
Fu et al. (2018)	Cross sectional	N = 876 (3 to 6-month children) country: New Zealand	Online survey questionnaire, CEBQ	- Less food fussiness in infants up to 36 months of age who were following BLW at 6–7 months of age rather than being TSF. - Food fussiness results were consistent with food fussiness being significantly lower for those following full BLW than TSF, and intermediate for those following partial BLW, at all three ages investigated. - Infants following BLW had a longer duration of exclusive BF, and at 6–7 months of age were almost twice as likely to consume red meat, but substantially less likely to consume iron-fortified infant cereal, than infants following TSF.	High
Gibson and Cooke (2017)	Overview	N/A	N/A	- Fussy eating and food neophobia are very common traits, with strong genetic components & environmental influences - Both breastfeeding and timely introduction of CF predicts food acceptance.	Low
Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Griffith et al. (2018)	Descriptive correlational study	N = 28 pre-term infants Country: USA	Anthropometrics, hospital charts for duration of tube feeding, oral feeding evaluation, Cogan videotape coding system, sucking device for nutritive sucking	- Significant negative correlation between duration of tube feeding and oral feeding success ($p = .000$) - No correlations between duration of tube feeding and alert behavioural states, orally directed behaviours or nutritive sucking	High
Harris et al. (2016)	Cohort study	N = 2016 (mothers & their 16-month-old twin children) country: UK	Sociodemographic & anthropometric measures, parental feeding style questionnaire, CEBQ	Differences in food fussiness were associated with differential 'pressure to eat' and 'instrumental feeding' ($p < .001$), but not with 'restriction'.	Above average

TABLE 4 (Continued)

Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Helland et al. (2017)	Cross sectional study	N = 505 parents of toddlers country: UK	CFNS, food frequency questionnaire, anthropometric & sociodemographic	- Mothers used more pressure ($p < .001$) and food rewards ($p < .05$) with the fussier twin. 'Pressure to eat' and 'instrumental feeding' were positively associated with 'food fussiness', while 'restriction' was negatively associated with 'food fussiness' ($p < .001$).	High
Holley et al. (2020)	Cross sectional study	N = 111 mothers of 2–4-year-old children country: UK	CFPQ, CEBQ, EAS	- Toddlers with higher CFNS scores had less frequent intake of vegetables ($p < 0.001$), berries ($p = 0.002$), fruits ($p < 0.001$), and fish ($p = 0.001$). - No significant associations for CFNS score and frequency of toddlers intakes of meat or of sweet and fatty snacks. - Food neophobia in toddlers is associated with lower diet quality - Mothers use of a range of positive (health-promoting) feeding practices was associated with greater enjoyment of food and lower food fussiness among children. - Relationships between mothers involving their children in food choice and preparation and childrens eating behaviours were moderated by childrens temperament. - Involvement in food choice and preparation was no longer associated with higher enjoyment of food and lower fussiness for children who were either highly emotional or low in sociability.	High
Hollis et al. (2016)	Cohort study	N = 2,389 mother child pairs from the Southampton Womens survey (SWS). Country: UK	Interviews with trained research nurse up until the age of 1. FFQ at the age of 3.	- Most mothers/carers (61%) reported some feeding difficulties at 3 years of age, specifically with their child eating enough food (61%), eating the right food (66%) and being choosy with food (74%). - Children who were introduced to solids ≥ 6 months had a lower risk of feeding difficulties than children who were introduced to solids between 4 and 6 months.	High
Johnson et al. (2016)	Cohort study	N = 1,130 LMPT and 1,255 term-born controls. Country: UK	A validated eating behaviour questionnaire, PARCA-R, parental questionnaire, BITSEA	LMPT infants were at increased risk of refusal/picky eating and oral motor problems at 2 years of corrected age.	Above average
Kaar et al. (2016)	Cross-sectional study	N = 210 parents of 3–5-year-olds country: USA	Food preference questionnaire, CFQ	The parent practice of offering new foods to eat was inversely associated with child food neophobia ($p < .0001$) and pressure to eat ($p = 0.07$).	High
Lee et al. (2019)	Cross-sectional study	N = 303 healthy children between 12 and 36 months country: Malaysia & Singapore	Anthropometric measures and parental interview	- There was a strong association between parental concerns regarding feeding issues of children & growth faltering. - Parents are twice as likely to be concerned with their child's feeding if there is poor weight gain than parents whose child is growing well.	Above average
Marlina et al. (2020)	Cross-sectional study	N = 113 kindergarten children country: Indonesia	Interviews	- There is a relationship between exclusive BF and the incidence of picky children. - There is a relationship between maternal parenting with the incidence of picky eater children	Above average

(Continues)

TABLE 4 (Continued)

Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Maslin et al. (2015)	Cohort study	N = 101 children aged between 7 and 13 years Country: UK	CEBQ, anthropometrics and demographics	- CME group scored significantly higher on 'slowness of eating' and on the combined 'avoidant eating behaviour' construct ($p < 0.01$). - There was no difference according to gender or infant feeding, but a higher number of excluded food allergens and symptoms were associated with more negative eating behaviour.	Low
Maslin et al. (2015)	Cross sectional study	N = 126 (8–30-month children) country: UK	Social demographics, picky eater questionnaire, Montreal Childrens hospital feeding difficulty questionnaire	- The CME group scored significantly higher for fussy eating and feeding difficulties ($p < 0.05$) - Feeding difficulties were found to be significantly positively correlated with several allergic symptoms, and both variables were found to be correlated with a higher volume of milk substitute consumed per day ($p < 0.05$).	Above average
Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Monnery-Paris et al. (2015)	Cohort study	N = 123 toddlers from 20 to 22 months country: UK	Food neophobia questionnaire, smell and test reactivity assessment	- Smell and taste differential reactivities were not correlated. - Food neophobia scores were modestly but significantly positively correlated with smell differential reactivity but not with taste differential reactivity. - When gender was considered, smell reactivity and neophobia were correlated only among boys.	High
Nederkoom et al. (2015)	Cross sectional study	N = 44 children between 4 and 10 years Country: Netherlands	Questionnaires, behavioural test of picky eating & tactile sensitivity	- Behavioural measures of tactile sensitivity are correlated to picky eating in a sample of younger children between 4 and 7.5 years. - A higher sensitivity to touch causes children to dislike the feel of foods in their mouth and therefore to dislike eating the foods.	Above average
Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Nicklaus (2016)	Critical review	N/A	N/A	- The most important phase is the beginning of complementary feeding. Infants discover the sensory (texture, taste and flavour) and nutritional properties (energy density) of the foods that will ultimately compose their adult diet. - Individual differences in food pleasure learning, related to temperamental dimensions, or to sensory sensitivity also must be considered.	Low
Oliveira et al. (2015)	Cohort study	N = 1,280 children at 4 months, 1,183 at 12 months, 1,077 at 24 months and 935 at 48 months	Parent interviews, BMI,	- Parents of children born small for gestational age (compared with appropriate gestational age) reported more often feeding difficulties and poor eating patterns at 4–6 months. - Overall, the effects decreased, after adjustment for child's BMI, but remained significant.	High
Pang et al. (2020)	Cohort study	N = 970 country: Singapore	Interviews regarding BF practices and CEBQ, infant feeding questionnaire, pre-schooler feeding questionnaire	- High breastfeeding was not associated with any other maternal reports of child feeding or eating behaviours. - No significant associations were observed between breastfeeding exposure & eating behaviour	Above average
Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Podlesak et al. (2017)	Cross sectional study	N = 525 (parents of 2–5-year-old children), country: USA	MAS, PSDQ	Positive correlations were found between an authoritative parenting style and non-picky eating behaviours.	Above average

TABLE 4 (Continued)

Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Rahill et al. (2019)	Cross sectional study	N = 594 (5–12-year-old children) country: Ireland	CEBQ, food neophobia scale, health & lifestyle questionnaire, anthropometric questionnaire,	• Authoritarian and permissive parenting styles were positively correlated with child behaviours associated with picky eating. • Childs food preferences as a barrier to providing them with a healthy diet was significantly associated with increased food fussiness in younger and older children ($p < 0.001$). • Higher levels of parental neophobia were significantly associated with an increase in food fussiness in younger and older children. • Food advertising as a barrier to providing a healthy diet was inversely associated with food fussiness in younger children ($p < 0.05$) • Family mealtimes in older children were associated with significantly lower levels of food fussiness ($p < 0.05$).	High
Ramos et al. (2017)	Cross sectional study	N = 70 children under the age of 10 Country: Brazil	Caregiver questionnaires, medical records	• No difference in FS or in the number of FS inadequateness according to FD diagnosis. • 94% of children presented at least one delayed development of FS; 1/3 presented delays in more than half of the FS. • The most prevalent inadequacies in FS were inappropriate feeding position (73.5%), prolonged bottle-feeding (56.9%), and inadequate self-feeding practices (37.9%).	Average
Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Reis et al. (2015)	Cohort study	N = 156 country: Canada	ECBQ, FFQ, CEBQ	• Inhibitory control is negatively related to the development of food fussiness later in childhood. • Consumption of n-3 PUFA was associated with decreased fussiness scored in IUGR children with poor inhibitory control.	Above average
Sanchez et al. (2018)	RCT	N = 217 children aged 3 (111 born < 30 weeks & 106 term born) country: Australia	BPFAS, parent report, SOMA	• Parents of children born < 30 weeks reported more feeding concerns than parents of term-born peers. • Chronic lung disease, NGT at discharge, neurodevelopmental diagnoses, and weight at 12 months predicted these outcomes.	Above average
Sandvik et al. (2018)	Cross sectional study	N = 1,272 country: UK	Swedish version of CEBQ, CFQ and anthropometrics	• Food responsiveness was lower for picky eaters, but the difference was significant only among children with obesity. • In the overweight and obesity groups, parents of picky eaters did not report as high pressure to eat, as compared to the thinness or normal weight groups. • In all weight status groups, parents of picky eaters reported their children had too much screen time, complained about physical activity, and expressed negative affect toward food.	Average
Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Smith et al. (2017)	Cohort study	N = 1921 (families with 16-month-old twins) country: UK	CEBQ	• FF & FN were strongly correlated ($p < 0.001$) • FF & FN shared a common aetiology, indicating high genetic and shared environmental correlations.	High
Specht et al. (2018)	Cohort study	N = 484 (children aged 2–6) country: UK	Parental questionnaire, dietary measurements	• Lower odds of picky eating behaviour when exclusively BF until age 4–5 months compared to exclusively BF for 0–1 month ($p = 0.008$).	Above average

(Continues)

TABLE 4 (Continued)

Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Tauman et al. (2017)	RCT	N = 75 (7–36-month children with FD, BI and typical) country: Israel	Demographics, SP, BISQ, BFAS	- Exclusively BF until age 6–10 months was associated with a higher daily intake of vegetables. - Exclusive BF duration influences pickiness and may contribute to facilitate the consumption of more vegetables in later childhood in obesity-prone normal weight children. - Children with either FD or BI reported by their caregivers showed more sensory difficulties compared to controls in the direction of ‘hypersensitive’ profile.	High
Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Taylor and Emmett (2019)	State-of-the-art review	N/A	N/A	- Identification of picky eating is hampered by lack of universally accepted definition & assessment tool. - Causes of picky eating include early feeding difficulties, late introduction of lumpy foods at weaning, the pressure to eat, and early choosiness, especially if the mother is worried by this; protective factors include the provision of fresh foods and eating the same meal as the child.	High
Thamer et al. (2015)	Cohort study	N = 4,823 children country: UK	Dutch version of CEBQ, measure for functional constipation, composite measure of prenatal and postnatal maternal anxiety and depressive symptoms	- Fussy eating in 4-year-old is associated with concurrent functional constipation & predicts subsequent functional constipation. - Functional constipation at a younger age is predictive of fussy eating behaviour at the age of 4 years.	Above average
van der Horst et al. (2016)	Cross sectional study	N = 2,371 (children between 12 and 47.9 months) country: USA	Telephone interviews with caregivers, child eating characteristics, 24-hour diet history	- Picky eaters were more neophobic, texture resistant & ate only favourite foods. - Picky eaters consumed less meat and other protein sources, less vegetables than non-picky children.	High
Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Verhage et al. (2018)	Review	N = 14	N/A	- Eating together as a family was associated with better nutrition, healthier food intake and fewer eating problems (e.g., fussiness and emotional eating). - Having structured mealtimes and family meals was associated with more food enjoyment and less fussy eating.	High
Walton et al. (2017)	Critical review	N/A	N/A	- Parent–child dyad affect is bidirectional and non-linear. Parents influence the actions and cognitions of children and children influence the actions and cognitions of parents. - Bi-directional models of causality are needed to correctly understand parent–child feeding interactions	High
Watson et al. (2018)	Review	N = 21	N/A	Children of parents with eating disorders have greater problems in feeding and eating behaviours, greater incidence of eating disorder symptoms & more negative parent–child interactions.	High
Werthmann et al. (2015)	Repeated measure design	N = 32 country: UK	Parental reports of childrens eating behaviour and parental feeding styles; and childrens BMI	- Food acceptance was affected by the texture of food, but not by colour or taste. - Parental report of childrens fussy eating behaviour and parental feeding styles were not related to behavioural observation of food acceptance.	High

TABLE 4 (Continued)

Reference	Study design	Study setting and population	Outcome measure	Results	Quality
Wolstenholme et al. (2020)	Systematic review	N = 10	N/A	- Synthesis identified two ways in which fussy eating relates to mealtime emotions (directly and via parent feeding practices) and three distinct categories of parent beliefs that relate to fussy eating (self-efficacy, attributions, and beliefs about hunger regulation). - The model proposes pathways that could be explored further in future qualitative and quantitative studies and suggests that parent beliefs, emotions, and awareness should be targeted alongside parent feeding practices to increase the effectiveness of interventions.	High

Note: For review articles, N = number of studies included.

Abbreviations: BF, Breastfeeding/Breastfed; BCHAAPS, Boston City Hospital Assessment of Parental sensitivity; VP, very preterm; VLBW, very low birth weight; FT, Full Term; CFQ, Child Feeding Questionnaire; CF, complementary food/feeding; SP, Sensory profile; CFNS, Child food neophobia scale; OLSF, Observation list spoon feeding; MOE, Mastication observation & Evaluation; CEBQ, Children Eating Behaviour Questionnaire; FPSQ28, Feeding Practices and Structure Questionnaire; BLW, Baby led weaning; TSF, Traditional spoon feeding; CFPQ, Comprehensive Feeding Practices Questionnaire; EAS, Emotionality Activity and Sociability Temperament Survey; CNE, Cows milk exclusion; PSDQ, Parenting Styles Dimensions Questionnaire; MAS, Mealtime Assessment Survey; FS, Feeding Scales; FD, Feeding Difficulties; SOMA, Schedule for Oro-motor Assessment; FF, Food Fussiness; FN, Food Neophobia; BI, Behavioural insomnia; BISQ, Brief Infant Sleep Questionnaire; BMI, Body Mass Index; CBCL, Child Behaviour Checklist; FFQ, Food Frequency Questionnaire; CEBI - Child Eating Behaviour Inventory; BSI, Brief Symptom Inventory; LMPT, Late and moderately preterm; PARCA-R, Parent Report of Childrens Abilities - Revised; BITSFA, The Brief Infant and Toddler Social Emotional Assessment Questionnaire; ECBQ, Early Childhood Behaviour Questionnaire.

Wolstenholme et al., 2020). All other included studies were of observational design (19 cohort studies: Harris et al., 2016; Maslin et al., 2016; Monnery-Patris et al., 2015; Smith et al., 2017; Specht et al., 2018; Amarger et al., 2015; Cardona Cano et al., 2015; Cole et al., 2018; Cole, Wang, et al., 2017; de Barse et al., 2017; de Barse et al., 2016; Emmett et al., 2018; Fildes et al., 2016; Hollis et al., 2016; Johnson et al., 2016; Oliveira et al., 2015; Pang et al., 2020; Reis et al., 2015; Tharner et al., 2015; 16 cross-sectional studies: Bell et al., 2018; Coulthard & Sahota, 2016; Finnane et al., 2017; Fu et al., 2018; Helland et al., 2017; Holley et al., 2020; Kaar et al., 2016; Marlina et al., 2020; Maslin et al., 2015; Nederkoorn et al., 2015; Podlesak et al., 2017; Rahill et al., 2019; Ramos et al., 2017; Sandvik et al., 2018; van der Horst et al., 2016; Lee et al., 2019; five longitudinal studies: Bilgin & Wolke, 2017; Boots et al., 2019; Costantini et al., 2019; Micali et al., 2016; Steinsbekk et al., 2017; one correlational study: Griffith et al., 2018, and one single cohort repeated measure study: Werthmann et al., 2015). Five (Cardona Cano et al., 2015; Cole et al., 2018; Cole, Wang, et al., 2017; de Barse et al., 2016; de Barse et al., 2017) of the 19 cohort studies analysed data from the same two cohorts (Generation R and Synergistic Theory: Cardona Cano et al., 2015; de Barse et al., 2017; de Barse et al., 2016; Research on Obesity and Nutrition Group: Cole et al., 2018; Cole, Wang, et al., 2017 [STRONG]) but collected at different times.

3.2 | Study participants and countries

Study participants were pre-school and school-aged children (up to 6 years) representing the general population. Samples were drawn from pre-schools, schools and outpatient settings such as child health centres. Most of the studies were conducted in the United Kingdom (28), the United States (6) and Australia (5). Three studies were conducted in Singapore and Malaysia, and one study each was conducted in Canada, New Zealand, Indonesia, Brazil and Israel.

3.3 | Study characteristics

Most studies focused on one or more types of feeding difficulties, including picky and fussy eating, food refusal or food neophobia. Of the 54 studies, three examined precursors of atypical feeding behaviours (Mallan et al., 2016; Micali et al., 2016; Steinsbekk et al., 2017), and 51 studies discussed the factors associated with feeding difficulties. Three studies assessed genetic factors (Amarger et al., 2015; Cole, Wang, et al., 2017; Fildes et al., 2016); five examined the impact of the duration of breastfeeding and the effect of expressed breast milk (Bell et al., 2018; de Barse et al., 2017; Dunn & Lessen, 2017; Pang et al., 2020; Specht et al., 2018) and four the timing of introduction of solid foods (Bell et al., 2018; Costantini et al., 2019; Emmett et al., 2018; Taylor & Emmett, 2019). Nine studies focused on parental feeding practices (Boots et al., 2019; Finnane et al., 2017; Harris et al., 2016; Holley et al., 2020; Kaar et al., 2016; Podlesak

et al., 2017; Taylor & Emmett, 2019; Walton et al., 2017; Wolstenholme et al., 2020), two on parent's mental health (de Barse et al., 2016; Watson et al., 2018) and two on the complementary feeding techniques (Bąbik et al., 2021; Fu et al., 2018) (baby-led weaning vs. traditional spoon-feeding). Five studies analysed sensory preferences (Coulthard & Sahota, 2016; Monnery-Patris et al., 2015; Nederkoorn et al., 2015; Steinsbekk et al., 2017; Tauman et al., 2017), four on effects of prematurity (Bilgin & Wolke, 2017; Griffith et al., 2018; Johnson et al., 2016; Sanchez et al., 2018) and two on effects of cow's milk exclusion (Maslin et al., 2015; Maslin et al., 2016). The remaining studies focused on a combination of these factors (Cardona Cano et al., 2015; Cole et al., 2018; da Costa et al., 2017; Gibson & Cooke, 2017; Helland et al., 2017; Hollis et al., 2016; Lee et al., 2019; Marlina et al., 2020; Nicklaus, 2016; Oliveira et al., 2015; Rahill et al., 2019; Ramos et al., 2017; Reis et al., 2015; Sandvik et al., 2018; Smith et al., 2017; Tharner et al., 2015; van der Horst et al., 2016; Verhage et al., 2018; Werthmann et al., 2015).

3.4 | Risk of bias

Twenty three of the 54 studies were of high quality, 21 were above average, 7 were average and 6 were of low quality. Of the 38 quantitative studies, 23 had a high risk of bias for at least one domain assessed. Of these 23 studies, 12 were cross-sectional, 9 were cohort designs, and 2 were longitudinal studies. Of the 16 qualitative studies, four were of high quality, two were of low quality, six were above average and four were of average quality. Most relied on parental reports for exposure data. Adjustment for confounding factors was not made in all studies, which raises concern for the high risk of bias.

3.5 | Studies focusing on precursors

Two longitudinal studies focused on predictors of childhood restrictive eating (Micali et al., 2016; Steinsbekk et al., 2017) and one on predictors for food preferences at 3.7 years based on foods tried at 14 months (Mallan et al., 2016).

3.5.1 | Predictors of childhood restrictive eating

One of the longitudinal studies confirmed that early signs of feeding difficulties are persistent and may predict eating problems in mid-childhood (Micali et al., 2016). Another longitudinal study reported that pickiness was moderately stable from pre-school to school age. About half of those children who displayed pickiness at the age of four were also picky eaters 2 years later (Steinsbekk et al., 2017). This study also suggested increased sensory sensitivity and low parental structuring predicted picky eating (Steinsbekk et al., 2017).

3.5.2 | Earlier introduction of fruits and vegetables

One of the RCT's explored predictors for food preferences concluded that trying a greater number of vegetables and fruits at 14 months predicted corresponding preferences and higher intakes at age 3.7 years (Mallan et al., 2016), and early signs of poor eating and growth are persistent and useful in predicting eating problems in mid-childhood (Micali et al., 2016).

3.6 | Studies examining factors associated with atypical feeding difficulties

3.6.1 | Breastfeeding and introduction of complementary foods

Thirteen studies focused on breastfeeding and the introduction of solid foods. Three cohort studies (de Barse et al., 2017; Pang et al., 2020; Specht et al., 2018) and two reviews (Bąbik et al., 2021; Harris & Coulthard, 2016) assessed effects of breastfeeding, whereas one longitudinal study (Costantini et al., 2019) and one cohort study (Hollis et al., 2016) examined the effects of the introduction of complementary/solid foods. One cross-sectional study assessed both breastfeeding and the introduction of complementary/solid foods (Bell et al., 2018). There were no RCTs examining the effects of breastfeeding and complementary foods on atypical feeding behaviours. All breastfeeding and complementary/solid food introduction studies discussed its association with atypical feeding behaviours. Few studies in our review endorsed a relationship between introduction of solid foods and its impact on feeding behaviours. For example, in a study of two European communities, early introduction of solids did not affect infants' willingness to eat, and no difference between exclusive and non-exclusive breastfed infants in terms of age of solid introduction was observed (Costantini et al., 2019). Some studies reported that a longer duration of exclusive breastfeeding might be associated with a lower risk of atypical feeding behaviours (de Barse et al., 2017; Specht et al., 2018), whereas others reported no significant association (Cardona Cano et al., 2015; Pang et al., 2020). Most studies reported a lower risk of feeding difficulties associated with introducing solid foods at or after 6 months (de Barse et al., 2017; Harris & Coulthard, 2016; Hollis et al., 2016).

3.6.2 | Impact of textures and complementary feeding techniques

Regarding the impact of textures on chewing abilities, there was a small but significant effect of providing more, larger and harder pieces to infants on their ability to chew pieces (da Costa et al., 2017). This two-arm randomized study confirmed that feeding infants with meals containing a higher number of larger pieces result in better chewing capability in general by increasing their oral-motor skills when they are around 7–8 months old (da Costa et al., 2017). Another study

showed that in addition to food neophobia and eating the same foods, texture resistance was significantly associated with picky eating (van der Horst et al., 2016). A cohort study by Emmett et al. (2018) identified that feeding difficulties during complementary feeding and introduction of lumpy foods after 9 months were associated with an increased likelihood of being picky. Another strong predictor was the child being choosy at 15 months, mainly if the mother was worried about this behaviour (Emmett et al., 2018). A cross-sectional study conducted in New Zealand demonstrated less food fussiness in infants up to 36 months of age who followed baby-led weaning at 6–7 months of age than the ones being traditionally spoon-fed.

3.6.3 | Genetic background

A study by Cole, Wang, et al. (2017) suggested that genes related to chemosensory perception play a role in children's picky eating behaviour. Another study supported the hypothesis that food fussiness and liking fruit and vegetables are genetically mediated. It might be why vegetables and fruits are the most commonly rejected food group by children (Fildes et al., 2016). The final study identified a common single nucleotide polymorphism (SNP) in the insulin receptor (INSR) gene associated with eating difficulties at 2 years of corrected age in pre-term infants (Amarger et al., 2015). These three studies emphasized that the genetic background may impact the feeding behaviour in young children (Amarger et al., 2015; Cole, Wang, et al., 2017; Fildes et al., 2016).

3.6.4 | Pre-term versus term-born infants

Bilgin and Wolke (2017) observed that feeding difficulties are commonly reported and linked with poorer maternal sensitivity in pre-term infants than their term-born peers. In comparison, Sanchez et al. (2018) reported that children born <30 weeks performed equivalent to their peers on the Behavioural Paediatric Feeding Assessment Scale (BPFAS); however, parents of pre-term children expressed more feeding concern than the parents of term-born children (Sanchez et al., 2018).

3.6.5 | Parental feeding practices

On the balance of evidence from studies in this review, parenting feeding practices were reported to negatively impact child food acceptance (Boots et al., 2019; Kaar et al., 2016; van der Horst et al., 2016). For example, a study on parental feeding practices reported that restrictive feeding practices negatively affect children's preferences for fruits and vegetables (Boots et al., 2019).

3.6.6 | Sensory preferences

A cross-sectional study suggested that there is a strong association between levels of tactile processing and food neophobia in both

young children and their parents (Coulthard & Sahota, 2016). On the other hand, a few studies focused on sensory preferences and reported that highly sensory sensitive children whose parents were also high on sensitivity and low on structuring displayed more pickiness over time (Steinsbekk et al., 2017). Also, young children with feeding difficulties or behavioural insomnia showed considerably more sensory challenges than their controls (Tauman et al., 2017).

4 | DISCUSSION

Our scoping review has synthesized findings from 54 studies on early emergence of atypical feeding behaviours in young children. Multiple factors potentially associated with atypical feeding behaviours in young children were identified in the review, including duration of breastfeeding, age of introduction of solid foods, complementary feeding techniques (traditional spoon-feeding vs. baby-led weaning) and sensory preferences.

We found inconsistent evidence for the association between the duration of breastfeeding and atypical feeding behaviours in young children (Cole, An, et al., 2017). In studies where children who were never breastfed were compared with those who breastfed, no significant differences in atypical feeding behaviours were observed (de Barse et al., 2017). This may indicate reverse causation (i.e., early feeding difficulties that induced breastfeeding cessation) rather than a protective effect of breastfeeding against atypical feeding behaviours. Mothers of fussy eaters may be fussy eaters themselves (Gibson & Cooke, 2017) and, therefore, likely to have limited dietary variety and limited intake of vegetables during the lactation period. In a Singapore cohort study (Pang et al., 2020), it was observed that the high breastfeeding group (exclusive breastfeeding for four or more months with continued breastfeeding for six or more months) had less difficulty in feeding at 3 years of age than in the low breastfeeding group (no breastfeeding or breastfeeding for less than 3 months). Children in the high breastfeeding group were less picky about food than children in the low breastfeeding group at 3 years of age but not at the age of six (Pang et al., 2020). For most children, picky eating tends to peak around 3 years, and any influence of prior breastfeeding exposure may be strongest within this timeframe (Cardona Cano et al., 2015). However, these differences were not statistically significant after adjusting for confounding factors such as appetite traits, expressed breastmilk and satiety responsivity. These findings indicate a lack of evidence for consistent associations between breastfeeding exposure and feeding difficulties in childhood.

There is inconsistent evidence, with a few studies demonstrating some association between age of introduction of solids and feeding difficulties, while others were focused more on the texture of foods than age of introduction. One study reported a combination of breastfeeding with the timely introduction of solid foods might influence the acceptance of new foods and predict the subsequent acceptance of foods such as fruit and vegetables (Bell et al., 2018). However, while breastfeeding is not a necessary prequel to a wide food acceptance, the timely and frequent introduction of solid foods

of differing tastes and textures is necessary (Harris & Coulthard, 2016). Regarding the timing of solid food introduction, the findings are similar for most studies. General feeding difficulties were reported to be less common among infants who were introduced to solid foods at or after 6 months of age as compared to infants who were introduced to solid foods between 4 and 6 months (de Barse et al., 2017; Harris & Coulthard, 2016; Hollis et al., 2016). Some studies have investigated the texture of foods in relation to picky eating status, but as cross-sectional studies, they did not assess specifically the timing of introducing textures (van der Horst et al., 2016). The ALSPAC study by Emmett et al. (2018) demonstrated that the age of introduction of lumpy foods was independently associated with the child being either somewhat or very picky at a later age, implying that the introduction of lumps before 10 months of age is important.

The complementary feeding techniques used to introduce solids also need to be considered. A cross-sectional study conducted in New Zealand (Fu et al., 2018) found a significantly lower food fussiness score in infants who followed baby-led weaning than being traditionally spoon-fed at the age of 6–7 months. In this same study, the duration of exclusive breastfeeding was strongly associated with weaning style and food fussiness. However, this study did not control confounding factors such as parent-reported weight data and mother's recall of feeding practices in early infancy. A systematic review by Bąbik et al. (2021) also found no association between feeding styles and food fussiness in children older than 1 year. These findings suggest that complementary feeding techniques such as baby-led weaning and traditional spoon-feeding do not affect feeding behaviours.

In a study focusing on sensory preferences, it was found that children with behavioural insomnia and feeding difficulties showed more sensory difficulties than their matched controls. Both groups demonstrated differences in oral and auditory processing. Interestingly, the sensation avoiding component was significantly different between both groups compared to controls. Overall, both groups had sensory processing differences, but it is unclear if it is specific to feeding difficulties due to the small sample and absence of clinical observations in this study. Another four studies focused on smell (Monnery-Patris et al., 2015), sensory sensitivity (Steinsbekk et al., 2017) and tactile processing (Coulthard & Sahota, 2016; Nederkoorn et al., 2015). While it has been reported that children who react differently to smells may not react differently to tastes and reactivity to smell was more pronounced in boys (Monnery-Patris et al., 2015), other studies suggested that children who are more sensory sensitive (taste, smell and tactile) at age four are at higher risk for pickiness 2 years later (Steinsbekk et al., 2017). However, this study did not control confounding factors such as parental approaches and genetic basis. Behavioural measures of tactile sensitivity are correlated to picky eating in younger children between 4 and 7.5 years (Nederkoorn et al., 2015). Similarly, even with the non-food-based stimuli, there was a strong negative relationship between enjoyment of sticky, messy play and levels of food neophobia in children (Coulthard & Sahota, 2016). It was found that levels of tactile sensitivity, food neophobia and enjoyment of tactile play had positive associations between the scores of children and those of their parents, suggesting similar levels of tactile processing in parents.

Overall, all these studies elucidated sensory preferences were significantly related to picky eating and food neophobia. However, they all had methodological flaws and need replication.

Given the pervasiveness and intensity of feeding difficulties (if left untreated) in young children, the need for early evidence-based intervention is clear. Further research is needed to develop a better understanding of how early emerging atypical feeding behaviours contribute towards persistent feeding difficulties later on in life.

It is essential to develop evidence-based guidelines and practical resources for parents and health professionals to help improve atypical feeding behaviours before they impact on child's health and family dynamics.

5 | LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

This scoping review followed the rigorous methodology recommended by PRISMA-ScR. This scoping review has identified that there are limited studies with a rigorous qualitative framework and a lack of an operational definition for picky eating.

Future studies are needed to address the methodological limitations of the extant literature. In particular, prospective studies that track specific long-term outcomes related to childhood feeding difficulties such as neurodevelopmental conditions such as autism, obesity, failure to thrive, family stress and nutritional deficiencies are warranted. There are also gaps in the current literature regarding the impact of child temperament on early feeding.

6 | CONCLUSION

This study identified multiple factors potentially associated with atypical feeding behaviours in young children. However, until there is an accepted definition for picky eating, there is insufficient evidence to guide early childhood practice and advice to families. More methodologically rigorous studies are needed to confirm and extend these findings.

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CONFLICT OF INTEREST

The authors have no relevant interest to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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