Food Parenting Practices and Children's Weight Outcome: A Systematic Review of Prospective Studies

Desi Beckers

Master Science Thesis

Supervised by:
1. Junilla Larsen
2. Jacqueline Vink

Date : June 24, 2019

Radboud University

Abstract

Background: Food parenting practices may importantly influence children's weight development. Previous reviews were primarily based on cross-sectional research. Therefore, this systematic review aimed to provide an overview of the prospective link between food parenting practices and children's weight outcome.

Methods: Three databases were searched. All titles, abstracts and full-texts were double screened by two independent reviewers. Peer-reviewed journal articles published after 1990 assessing the prospective association of food parenting practices with weight outcome of children aged 2-18 years were eligible. Reference list of eligible articles were hand-searched to identify additional articles.

Results: In total, 40 studies were found eligible, focusing on 12 different food parenting practices. Restriction, pressure to eat and monitoring were not associated with children's weight over time. Also most studies on food availability and accessibility found null-findings, although studies often only assessed small aspects of these practices. Instrumental—but not emotional—feeding was associated with higher weight over time. Results regarding the link between frequency of mealtime results were mixed. Other structure-related (e.g., rules and limits, modeling of healthy eating) and autonomy supporting (e.g., encouragement) food parenting practices were understudied.

Conclusion: Food parenting practices that received most attention within prospective studies (i.e., restriction, pressure to eat, monitoring) were not associated with children's weight outcome over time. Further, results indicate that associations of instrumental and emotional feeding with weight outcome should be examined separately. Future research should focus more on structure-related and autonomy supporting food parenting practices, and develop and validate questionnaires measuring these food parenting practices.

Food Parenting Practices and Children's Weight Outcome: A Systematic Review of Prospective Studies

In recent decades, the prevalence of childhood obesity has increased rapidly [1]. This is alarming, as childhood obesity is associated with an increased risk for developing chronic diseases, including type 2 diabetes, cardiovascular disease and cancer [2, 3], and often tracks into adulthood [4]. Moreover, children with obesity are more likely to experience mental health problems (e.g., anxiety and depression) and social problems (e.g., victim of bullying and discrimination) compared to healthy weight children [2]. To tackle this health epidemic, it is urgent to identify modifiable risk and protective factors of childhood obesity.

Obesity refers to excess body fat [5] and develops when energy intake persistently exceeds energy expenditure [6]. An important contributor to this energy balance is children's eating behavior, which is largely shaped within the family environment [7]. The family environment consists of various components, including family member's characteristics (e.g., personality) and behaviors, and interactions between family members [8]. Research suggests that parents play an important role in the development and maintenance of children's eating behaviors [9]. Parents may influence their children's eating through food parenting practices, which are food-specific, goal-oriented acts of parenting [10].

Food parenting practices can be categorized into three overarching constructs: coercive control, structure and autonomy support [11, 12]. Coercive control refers to pushing and dominating the child to behave according to parents' desires (e.g., pressure to eat, restriction). These food parenting practices tend to be parent-centered approaches, focusing on parents' goals without explicit attention to the child's needs. Hence, these practices may have an adverse impact on children's weight development. Structure refers to how parents organize the child's food environment to promote the child's competence (e.g., modeling of healthy eating, repeated exposure). Autonomy support refers to enhancing the child's independence

and autonomy in making healthy choices themselves (e.g., encouragement, non-food rewards). As structure-related and autonomy supporting parenting practices reflect parents' approaches to support and guide the child to eat healthy while accounting for the child's emotional and psychological needs, these food parenting practices may have a favorable impact on children's weight development [12].

To date, systematic reviews on experimental research give adequate insight into the effects of specific food parenting practices on children's healthy eating (particularly fruit and vegetable intake). These reviews indicated that modeling of healthy eating, repeated exposure and using non-food rewards are effective strategies to increase children's fruit and vegetables intake [13, 14], whereas pressure to eat often had the opposite effect of intended, namely decreased food intake [13]. In contrast, little is known about the influence of food parenting practices on children's weight development. Previous systematic reviews on food parenting practices and children's weight suggested that more restriction and less pressure to eat were associated with a higher weight [15, 16]. However, these results were primarily based on cross-sectional designs. As associations of food parenting practices with children's weight may result from parents influencing as well as responding to children's weight [8], the directionality of these associations is yet unclear. Over the past years, the number of longitudinal studies towards the link of food parenting practices with child weight has increased. Summarizing prospective research will be valuable for unraveling the causal associations of food parenting practices with children's weight.

The aim of this systematic review was to gain insight into the association of food parenting practices with children's weight outcome over time. Longitudinal articles published between January 1990 and October 2018 examining the prospective association between food parenting practices and children's weight outcome were reviewed. This review will not only

be valuable for childhood obesity prevention and intervention, but also highlight gaps within the literature and thereby provide directions for future research.

Methods

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines [17]. The review was preregistered in PROSPERO (registration number: CRD42018114793)

Search strategy

A literature search performed in Web of Science, PubMed and PsycINFO was carried out in October 2018. The search strategy (see Appendix A) consisted of a combination of search words related to food parenting practices (e.g., food parenting, child feeding), children (e.g., child, adolescent), weight outcome (e.g., body mass index, fat mass) and prospective study design (e.g., longitudinal, long-term). Searches were limited to articles in English language and published after 1990. The reference lists of included studies were hand-searched to identify additional eligible articles.

Eligibility criteria

For eligibility, studies had to meet the following criteria: (1) prospective study design; (2) examining the prospective association of at least one food parenting practice for children aged 2-18 years (mean age) with at least one child weight outcome; and (3) using quantitative research methods. Deviating from the preregistration, we included articles using data from intervention studies. For these articles we additionally required that: (4) the intervention did not contain a parental component; and (5) the intervention effect was not of interest.[1]

[1] If interventions do not include a parental component, we expect no influence from the intervention on the association between food parenting practices and children's weight outcome. Studies using data from such intervention studies are therefore considered relevant to this review.

Studies were excluded if they: (1) were not published in English; (2) were not published in a peer-reviewed journal; (3) were published before 1990; (4) focused on children with mental or physical health problems (e.g., eating disorders, autism); (5) used an experimental or case-control study design; or (6) presented not-original research finding (e.g., review). Deviating from the preregistration, we additionally excluded articles (7) using a restricted study sample, for example only including children with very high or low scores on picky eating.[2]

Food parenting practices

Food parenting practices of interest were those that could be classified into one of the overarching food parenting domains: coercive control, structure, autonomy support (see [11, 12]. Since structure and autonomy are considered to have a positive influence on children's eating and coercive control a negative influence on children's eating [12], food parenting practices representing a combination of coercive control with structure or autonomy support were excluded. Parenting practices representing a combination of structure and autonomy support (e.g., food availability and encouragement) were included and mentioned twice. Since some articles used different terms for the same concept or vice versa, the labels for some food parenting practices were changed using a food parenting practice conceptual map [11].

Child weight outcome

Weight outcomes included in this review were (change in) body mass index (BMI), BMI *z*-score (*z*BMI), BMI percentiles, weight for length *z*-score (*z*WFL), weight status (e.g., healthy, overweight, obese), weight trajectory, total fat mass (TFM), fat mass index (FMI), percentage body fat, waist circumference (WC), and waist-to-height ratio (WHtR), tricep skinfold, and subscapular skinfold.

[2] Using such a restricted sample makes it impossible to generalize the results to the population from which the full sample was drawn.

Study selection and data extraction

First, all titles and abstracts were double screened by DB (100%) and either JL (50%), LK (25%) or JV (25%). Second, full-texts of potentially eligible articles were retrieved and assessed for eligibility by two independent reviewers (DB and JL). All disagreements were resolved by discussion until consensus was reached. During the screening phases, an extraction table was created. This table included information regarding study characteristics, research design, study aim, participant information, measurements, statistical analysis, and results (Appendix B). One reviewer (DB) extracted the data into the extraction table.

If a full-text article was not available or relevant information was missing, the first or corresponding author was contacted by email. If the full-text article or relevant information could not be obtained, the article or parts of the analyses were excluded from the review.

Study quality assessment

The quality of included reports was assessed by one reviewer (DB) using an adapted version of the 14-item National Heart, Lung and Blood institute's Quality Assessment Tool for Observational Cohort and Cross-sectional Studies [18]. Two criteria were considered not applicable to the included studies and thereby omitted (i.e., groups recruited from the same population; blinding of outcome assessors). Articles were thus evaluated on 12 criteria (Table 1), which were scored between 0-1 (see Appendix C for the full scoring guide). If we could not determine whether a criterion was met, the criterion was scored 0. The overall rating of the articles was based on the sum score and the score of three key criteria (i.e., 5. Exposure measured prior to outcome; 8. Exposure measured reliable/valid; 12. Adjusted for potential key confounders). Articles were given an overall rating "Good" if they had a sum score of at least 9 and scored at least 0.5 at all three key criteria. Articles received an overall rating "Fair" if they had a sum score between 6 and 8.5, or if they had a sum score of at least 9 but scored 0

on (at least) one of the key criteria. Articles with a sum score 6 or lower received an overall rating “Poor”.

Table 1

Adapted Quality Assessment Tool

	Criteria
1.	Was the research question or objective in this paper clearly stated?
2.	Was the study population clearly specified and defined?
3.	Was the participation rate of eligible persons at least 50%?
4.	Was the sample size large enough?
5.	For the analyses in this paper, were the exposure(s) of interest measure prior to the outcome(s) being measured?
6.	Was the time frame sufficient so that one could reasonably expect to see an association between exposure and outcome if existed?
7.	For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome?
8.	Were the exposure measures clearly defined, valid, reliable and implemented consistently across all study participants?
9.	Was the exposure(s) assessed more than once over time?
10.	Were the outcome measure(s) clearly defined, valid, reliable and implemented consistently across all study participants?
11.	Was loss to follow-up after baseline 20% or less?
12.	Were key potential confounding variables measured, and adjusted statistically for in their impact on the relationship between exposure(s) and outcome(s)?

Note. Adapted from the National Heart, Lung and Blood institute’s Quality Assessment Tool for Observational Cohort and Cross-sectional Studies.

Results

The initial literature search provided in total 1777 records, representing 1408 unique studies. After screening titles and abstracts, 62 studies were retained for full-text screening. Of these studies, 33 were found eligible for inclusion. By hand-searching the reference lists of eligible studies seven additional studies were identified, resulting in a total of 40 included studies, which were based on 30 unique datasets (see Figure 1).

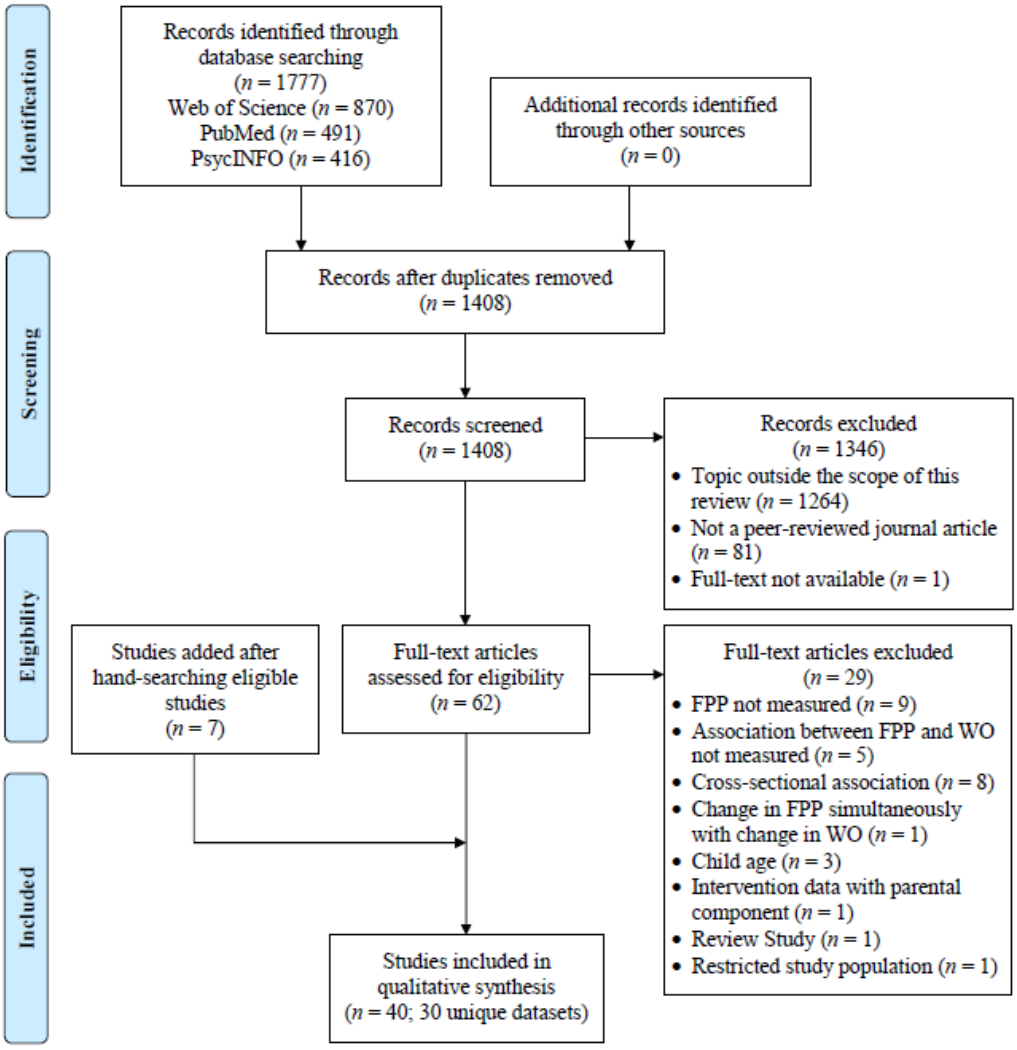

Figure 1. PRISMA flow diagram of the review process including reasons for exclusion.

Note. FPP = Food parenting practices; WO = Weight outcome.

Study Characteristics

Characteristics of the studies are presented in Table 2. Sample sizes—the number of children in the analytic sample for longitudinal analyses—ranged from 57 to 10,995. Twenty-two studies were conducted in the United States, ten in Europe, seven in Australia and one in Asia. Most studies focused on preschoolers (*n* = 22), followed by school-agers (*n* = 10), both school-agers and adolescents (*n* = 5), adolescents (*n* = 2), and both preschoolers and school-agers (*n* = 1). Most studies (*n* = 25) reported the caregiver's gender, with 20 studies only including mothers. The majority of studies were prospective observational cohort studies (*n* = 38), with only two being eligible prospective intervention cohort studies.

Most studies used parent-report questionnaires to assess food parenting practices (*n* = 31), with one study combining parent-report questionnaires with observation to assess pressure to eat and restriction. Nine studies assessed food parenting practices with child-report questionnaires. In total, 24 studies included validated questionnaires to measure food parenting practices. The Child Feeding Questionnaire, assessing restriction, pressure to eat and monitoring, was used most often (*n* = 17). Other instruments were used less frequently (i.e., Parental Feeding Style Questionnaire, *n* = 3; Comprehensive Feeding Style Questionnaire, *n* = 3; Over and Covert Control Scale, *n* = 3; Infant Feeding Style Questionnaire, *n* = 2; Preschooler Feeding Questionnaire, *n* = 1; Parental Feeding Practices Questionnaire, *n* = 1). These instruments were mainly used to measure coercive controlling practices (e.g., restriction, pressure to eat, overt control, instrumental and emotional feeding), covert control and encouragement. Regarding weight outcome, 26 studies used objective measures for the vast majority (> 95%) of participants. The remaining studies used for a substantial proportion (> 35%) of the participants some self-report measurements to assess child weight outcome (*n* = 13), or did not report how weight outcome was measured (*n* = 1).

Regarding the quality appraisal (see Appendix D for the full rating), most studies (*n* = 29) were rated as fair, while five studies were rated as good and six studies as poor. All studies met the criteria of clearly stating the study objective, and using a sufficient time frame to identify a potential effect. Moreover, 39 studies assessed food parenting prior to weight outcome (i.e., one study used change in overweight status at outcome measure, but assessed food parenting practices after the first measure of height and weight). On the other hand, none of the studies provided a sample size justification, and only a small number of studies assessed food parenting practices more than once over time (*n* = 10), and reported loss to follow-up rates below 20% (*n* = 12).

Table 2

Study Characteristics and Results (Alphabetically Ordered)

Reference, year, country	Sample[1]	Study length[2]	FPP	Method to assess FPP	WO	Method to assess WO	Key findings	Quality rating
Afonso et al. [19], 2016, Portugal	*N* = 3,708 4-year-olds 48.5% girls	3 years	Restriction; Monitoring; Pressure; Overt control; Covert control	CFQ; CFQ; CFQ; Overt Control Scale; Covert Control Scale	*z*BMI	Objective measures	**More pressure to eat and more overt control preceded lower *z*BMI at follow-up.** Monitoring, restriction and covert control were not associated with zBMI over time.	Good
Agras et al. [20], 2004, United States	*N* = 150 2-year-old 50.7% girls	7.5 years	Restriction; Instrumental and emotional feeding*	SFQ; SFQ	Overweight status	Not reported	Restriction and instrumental/emotional feeding were not associated with overweight status at age 9.5.	Poor
Anderson et al. [21], 2017, United Kingdom	*N* = 10,995 3-year-olds 49.7% girls	8 years	Regularity mealtime	One question asking if the child has meals at regular times.	Obesity status	Objective measures	**Not always (compared to always) having a regular mealtime was associated with lower odds for obesity at follow-up**.	Fair
Anzman and Birch [22] 2009, United States	*N* = 197 7-year-olds 100% girls	8 years	Restriction	CFQ	BMI; Change in BMI	Objective measures	Main effect of restriction not reported. **However, low inhibitory/high restriction group showed a higher (change in) BMI than both high inhibitory groups.** No other significant differences were found.	Fair

Table 2

Continued

Reference, year, country	Sample[1]	Study length[2]	FPP	Method to assess FPP	WO	Method to assess WO	Key findings	Quality rating
Berge et al. [23], 2015, United States	*N* = 2,117 Two age cohorts: 12.8 (0.7) year-olds 15.9 (0.8) year-olds 55% girls	10 years	Frequency of family meals	One question assessing how many times in the past seven days, the family ate a meal together.	Weight status	Self-report	**More frequent family meals was linked with lower odds for being overweight at follow-up. Only for black adolescents, more frequent family meals was linked with lower odds for being obese at follow-up.**	Fair
Bergmeier et al. [24], 2015, Australia	*N* = 79 2-5-year-olds 54.4% girls	1 year	Restriction; Pressure	CFQ, Observation CFQ, Observation	*z*BMI	Objective measures	**Higher levels of observed** (but not reported) **restriction preceded lower *z*BMI.** Pressure to eat was not linked with *z*BMI at follow-up.	Fair
Bergmeier et al. [25], 2014, Australia	*N* = 201 2-5-year-olds 57.7% girls	1 year	Restriction; Monitoring; Pressure	CFQ CFQ CFQ	*z*BMI	Self-report	None of the food parenting practices were associated with *z*BMI at follow-up.	Fair
Campbell et al. [26], 2010, Australia	*N* = 392 Two cohorts: 5-6-year-olds 10-12-year-olds 49.7% girls	3 years	Restriction**	CFQ	*z*BMI	Objective measures At follow-up self-report for 10 children	**Higher levels of restriction preceded lower *z*BMI at follow-up for 5-6 year-olds**, but not 11-12 year-olds.	Fair

Table 2

Continued

Reference, year, country	Sample[1]	Study Length[2]	FPP	Method to assess FPP	WO	Method to assess WO	Key findings	Quality rating
Chang and Gable [27], 2013, United States	*N* = 6,220 10-12-year-olds 51% girls	3 years	Frequency of family dinner; Frequency of family breakfast	One question assessing how often in a week the family eats dinner together. One question assessing how often in a week the family eats breakfast together.	Weight trajectory	Objective measures	**Having more frequent family breakfast** (but not dinner) **was associated with higher odds for moving from overweight towards a healthy weight compared to being stable overweight.**	Fair
Chang and Halgunseth [28], 2015, United States	*N* = 6,860 11-year-olds 51% girls	3 years	Frequency of family meals	Two questions asking how many times in a week the family eats dinner/breakfast together.	Weight trajectory	Objective measures	**Compared to white/non-Hispanic adolescents, Hispanic adolescents from less acculturated families who had more frequently family meals in the presence of low parental control were less likely to make a healthy change (for overweight adolescents at baseline) and more likely to make an unhealthy change (for healthy adolescents at baseline).**	Fair

Table 2

Continued

Reference, year, country	Sample[1]	Study Length[2]	FPP	Method to assess FPP	WO	Method to assess WO	Key findings	Quality rating
Chong et al. [29], 2017, United Kingdom	*N* = 7,312 3.5-year-olds 49.2% girls	11.5 years	Guided or limited choices; Emotional feeding	One question asking how much choice the child had in deciding what to eat. One question asking how often the parent uses food to regulate emotions.	*z*BMI; TFM	Objective measures	**More parental food-choice control at baseline was associated with lower *z*BMI and TFM at age 15**, but not with *z*BMI at age 7. Emotional feeding at baseline did not predict weight outcome at age 7 and 15.	Fair
Crossman et al. [30], 2006, United States	*N* = 6,378 15.28 (1.61) years old 50.7% girls	6 years	Unstructured practices	One question asking Whether the parents let the child make his/her own decisions about what to eat.	Overweight status	Baseline: Self-report Follow-up: Objective measures	**Higher levels of unstructured practices increased the likelihood for being overweight in young adulthood for boys,** but not girls.	Poor
Derks et al. [31], 2017, The Netherlands	*N* = 4,689 4-year-olds 50.5% girls	6 years	Restriction	CFQ	*z*BMI	Objective measures	Restrictive feeding at age 4 was not associated with *z*BMI at age 10.	Good

Table 2

Continued

Reference, year, country	Sample[1]	Study Length[2]	FPP	Method to assess FPP	WO	Method to assess WO	Key findings	Quality rating
Faith et al. [32], 2004, United States	*N* = 57 5-year-olds Gender not reported	2 years	Restriction; Monitoring; Pressure	CFQ CFQ CFQ	*z*BMI	Objective measures	**More restriction preceded higher *z*BMI among high-risk families (i.e., high maternal pre-pregnancy weight) only. More pressure to eat preceded lower *z*BMI among high-risk families only. More monitoring preceded lower *z*BMI among low-risk families (i.e., low maternal pre-pregnancy weight) only.**	Fair
Faith et al. [33], 2006, United States	*N* = 825 1-5-year-olds 46.8% girls	1-4 years	Restriction; Pressure; Offering fruits; Offering vegetables	One question asking if parents limit intake; One question asking if parents agree that 'children need to finish dinner before dessert'; One question asking if parents tried to offer more fruits; One questions asking if parents tried to offer more vegetables.	Change in *z*BMI	Objective measures	None of the food parenting practices were associated with change in *z*BMI.	Poor

Table 2

Continued

Reference, year, country	Sample[1]	Study Length[2]	FPP	Method to assess FPP	WO	Method to assess WO	Key findings	Quality rating
Francis and Birch [34], 2005, United States	*N* = 171 5-year-olds 100% girls	4 years	Restriction	CFQ	Change in BMI	Objective measures	**For overweight mothers only, more restriction preceded a larger increase in BMI from age 5 to 9.**	Good
Fulkerson et al. [35], 2013, United States	*N* = 422 5.8 (0.5) years old 49% girls	2 years	Rules and limits	PFSQ	Overweight status; *z*BMI; Tricep skinfold; Subscapular skinfold; WC; % Body fat	Objective measures	Rules and limits were not linked to anthropometric outcomes.	Fair
Fulkerson et al. [36], 2008, United States	*N* = 2,516 Two cohorts: 12.8 (0.7) years old 15.9 (0.9) years old 55.1% girls	5 years	Frequency of family meals	One question assessing how many times during the past seven days the family ate a meal together.	Overweight status	Self-report	Frequency of family meals was not associated with weight outcome.	Fair

Table 2

Continued

Reference, year, country	Sample[1]	Study Length[2]	FPP	Method to assess FPP	WO	Method to assess WO	Key findings	Quality rating
Gable et al. [37], 2007, United States	*N* = 8,000 68.4 (4.1) months old 52% girls	3 years	Frequency of family meals	Two questions about how frequently the family eats dinner/ breakfast together	Weight trajectory	Objective measures	**Having more frequent family meals was associated with lower odds for becoming overweight.**	Fair
Gregory et al. [38], 2010, Australia	*N* = 106 2-4-year-olds 51% girls	1 year	Restriction; Monitoring; Pressure; Modeling of healthy eating	CFQ; CFQ; CFQ; Three questions asking whether parents eat (un)healthy foods in front of their child.	*z*BMI	Self-report	None of the food parenting practices were associated with *z*BMI at follow-up.	Fair
Gubbels et al. [39], 2011, The Netherlands	*N* = 1,513 5-year-olds 48.8% girls	2 years	Restriction; Monitoring; Stimulation of healthy eating***	CFQ; CFQ Two questions asking whether parents make sure their child eats enough healthy foods and make their child enthusiastic about healthy foods.	*z*BMI	Self-report	**More stimulation of healthy eating preceded lower *z*BMI at follow-up.** Monitoring and restriction were not associated with *z*BMI.	Fair

Table 2

Continued

Reference, year, country	Sample[1]	Study Length[2]	FPP	Method to assess FPP	WO	Method to assess WO	Key findings	Quality rating
Hughes et al. [40], 2016, United States	*N* = 129 4-5-year-olds 45% girls	18 months	Restriction; Monitoring; Pressure	CFQ CFQ CFQ	*z*BMI	Objective measures	**More monitoring preceded lower *z*BMI at follow-up. More restriction preceded higher *z*BMI at follow-up.** Pressure to eat was not associated with *z*BMI at follow-up.	Fair
Jansen et al. [41], 2014, The Netherlands	*N* = 4,166 2-year-olds 50.3% girls	4 years	Restriction; Monitoring; Pressure (4y) Pressure (2y)	CFQ CFQ CFQ Five questions asking what parents do when their child does not eat (e.g., convince to eat).	*z*BMI	Objective measures	**Higher levels of pressure to eat at age 4** (but not age 2) **preceded lower *z*BMI at 2-year follow-up.** Monitoring and restriction at age 4 were not associated with future *z*BMI.	Fair
Lehto et al. [42], 2012, Finland	*N* = 534 9-11-year-olds 52.4% girls	2 years	Mealtime rules; Frequency of family meals	Three questions asking if parents have structuring rules during mealtimes. One question asking how children have dinner/breakfast during school days.	BMI; WHtR	Objective measures	**More parenting practices at meals preceded lower BMI**, but not WHtR, **at follow-up**. Frequency of family meals was not associated with weight outcome.	Fair

Table 2

Continued

Reference, year, country	Sample[1]	Study Length[2]	FPP	Method to assess FPP	WO	Method to assess WO	Key findings	Quality rating
Liszewska et al. [43], 2018, Poland	*N* = 526 6-11-year-olds 56.8% girls	10 months	Restriction; Pressure; Unstructured practices	CFPQ; CFPQ; Two questions asking if the child is allowed to have sweets/soft drink whenever he/she wants.	BMI percentiles	Objective measures	**More restriction preceded higher BMI percentile at 10-months follow-up.** Pressure to eat and unstructured practices were not associated with BMI percentiles.	Fair
Lumeng et al. [44], 2017, United States	*N* = 222 27-month-olds 47.7% girls	6 months	Restriction; Pressure; Restrictive monitoring; Encouragement; Emotional feeding; Unstructured practices	IFSQ; IFSQ; IFSQ; IFSQ; IFSQ; IFSQ;	Overweight status	Objective measures	None of the food parenting practices were associated with weight outcome at follow-up.	Fair
Lumeng et al. [45], 2018, United States	*N* = 222 27-month-olds 44.6% girls	6 months	Pressure	IFSQ	zWFL	Objective measures	Pressure to eat was not associated with weight outcome at follow-up.	Fair

Table 2

Continued

Reference, year, country	Sample[1]	Study Length[2]	FPP	Method to assess FPP	WO	Method to assess WO	Key findings	Quality rating
Mason et al. [46], 2018, United States	*N* = 1,547 15.0 (1.6) years old 55.5% girls	16 years	Healthy food availability; Unhealthy Food availability; Frequency of family meals	Three questions asking how often healthy products are at home. Three questions asking how often unhealthy products are at home. One question asking how often in the past seven days, the family ate a meal together.	BMI	Baseline: Not reported Follow-up: Self-report	Healthy food availability, unhealthy food availability and frequency of family meals were all not associated with weight outcome.	Fair
McPhie et al. [47], 2012, Australia	*N* = 117 2-4-year-olds 53.8% girls	1 year	Restriction; Pressure	CFQ; CFQ	Change in *z*BMI	Self-report	**More pressure to eat preceded a larger increase in *z*BMI.** Restriction did not precede change in *z*BMI.	Fair
Quick et al. [48], 2013, United States	*N* = 1,643 15.0 (1.6) years old 53.1% girls	10 years	Healthy food availability Unhealthy food availability	Three questions. Three questions.	Overweight status	Self-report	Healthy and unhealthy food availability were both not associated with weight outcome.	Fair

Table 2

Continued

Reference, year, country	Sample[1]	Study Length[2]	FPP	Method to assess FPP	WO	Method to assess WO	Key findings	Quality rating
Rhee et al. [49], 2009, United States	*N* = 789 4-year-olds 52.3% girls	5 years	Unstructured practices	One question asking if the child can eat what (s)he feels like eating.	Change in *z*BMI	Objective measures	**Compared to no change, decreased unstructured practices were linked to lower odds for increasing *z*BMI for boys only.** Increased unstructured practices were not associated with change in *z*BMI.	Fair
Rodenburg et al. [50], 2014, The Netherlands	*N* = 1,184 9-year-olds 49.5% girls	1 year	Rules and limits; Covert control Encouragement; Emotional feeding; Instrumental feeding	PFSQ; Three questions from Covert Control Scale; PFSQ; PFSQ; PFSQ	*z*BMI	Objective measures	**More instrumental feeding and covert control preceded higher *z*BMI at follow-up.** None of the other parenting practices were associated with weight outcome.	Fair
Rodgers et al. [51], 2013, Australia	*N* = 222 1.5-2.5-year-olds Gender not reported	1 year	Restriction; Pressure; Monitoring; Covert control; Encouragement; Emotional feeding; Instrumental feeding****	Principal component analysis using the CFQ, PFSQ, CFPQ, PFQ, Overt Control Scale, Covert Control Scale.	Change in *z*BMI	Baseline: Objective Follow-up: Objective 64.1% Self-report 35.1%	**Instrumental feeding was positively associated with change in *z*BMI.** None of the other parenting practices were associated with weight outcome.	Poor

Table 2

Continued

Reference, year, country	Sample[1]	Study Length[2]	FPP	Method to assess FPP	WO	Method to assess WO	Key findings	Quality rating
Rodgers et al. [52], 2013, Australia	*N* = 220 1.5-2.5-year-olds 53.2% girls	1 year	Restriction	CFPQ	Change in *z*BMI	Baseline: Objective Follow-up: Objective 64.1% Self-report 35.1%	Restriction was not associated with change in *z*BMI.	Poor
Sen [53], 2006, United States	*N* = 3,774 12-15-year-olds 47.5% girls	3 years	Frequency of family dinner	One question asking how often in a week the family eats dinner together.	Weight trajectory	Self-report	**Some indication that having family meals, compared to no family meals, was associated with lower odds for moving into overweight for non-Hispanic White adolescents, and higher odds for ceasing to be overweight for non-Hispanic White, Black and Hispanic White adolescents.**	Poor
Spruijt-Metz et al. [54], 2006, United States	*N* = 121 11.0 (1.7) years old 61.2% girls	1-4 year	Restriction; Pressure; Monitoring	CFQ; CFQ; CFQ	TFM	Objective measures	None of the parenting practices were associated with weight outcome.	Fair

Table 2

Continued

Reference, year, country	Sample[1]	Study Length[2]	FPP	Method to assess FPP	WO	Method to assess WO	Key findings	Quality rating
Taveras et al. [55], 2005, United States	*N* = 10,420 Two cohorts: 9-12-year-olds 13-14-year-olds 53.9% girls	3 years	Frequency of family dinner	One question assessing how often the child eats dinner together with the family.	Weight trajectory	Self-report	Frequency of family dinner was not associated with weight outcome.	Fair
Tschann et al. [56], 2015, United States	*N* = 322 8-10-year-olds 53% girls	2 years	Restriction; Pressure; Instrumental and emotional feeding; Encouragement	PFPQ; PFPQ; PFPQ; PFPQ	WHtR; BMI	Objective measures	**More restriction at T1 preceded higher WHtR at T2. Paternal restriction at T2 preceded higher WHtR at T3 for boys, but lower WHtR at T3 for girls. Pressure to eat at T1 preceded lower WHtR at T2 for boys only. Paternal encouragement at T2 preceded higher WHtR at T3 for boys only.** Other associations were not significant.	Good
Tung and Yeh [57], 2014, Taiwan	*N* = 465 Age at 1-year follow-up: 8.4 (1.2) years old 50.3% girls	1 year	Restriction; Monitoring; Pressure	CFQ; CFQ; CFQ	Overweight status	Objective measures	**More monitoring was linked with higher odds for overweight for more authoritarian mothers, and lower odds for overweight for more authoritative mothers.** Other associations were not significant.	Good

Table 2

Continued

Reference, year, country	Sample[1]	Study Length[2]	FPP	Method to assess FPP	WO	Method to assess WO	Key findings	Quality rating
Webber et al. [58], 2010, United Kingdom	*N* = 113 7-9-year-olds 50.7% girls	3 years	Restriction; Monitoring; Pressure	CFQ; CFQ; CFQ	BMI; FMI; WC	Objective measures	None of the food parenting practices were associated with weight outcome.	Fair

Note. FPP = Food Parenting Practices; WO = Weight Outcome; CFQ = Child Feeding Questionnaire; SFQ = Stanford Feeding Questionnaire; PFSQ = Parental Feeding Style Questionnaire; CFSQ = Comprehensive Feeding Style Questionnaire; IFSQ = Infant Feeding Styles Questionnaire; PFQ = Preschooler Feeding Questionnaire; PFPQ = Parental Feeding Practices Questionnaire; BMI = Body mass index; *z*BMI = Body mass index *z*-score; TFM = Total fat mass; *z*WFL = Weight for length *z*-score; WHtR = Waist-to-height ratio; WC = Waist circumference.

Bold font indicates significant associations.

[1] Characteristics of the analytic sample for longitudinal analysis with age at baseline.

[2] Study length relevant to this review.

* Study also focused on maternal prompts which referred to a combination of encouragement (i.e., autonomy support) and pressure to eat (i.e., coercive control). Therefore, this food parenting practice was not included in this review.

** Study also focused on instrumental feeding, but longitudinal associations with weight outcome were not reported and could not be obtained after contacting the authors. Therefore, this food parenting practice was not included in this review.

*** Stimulation of healthy food intake referred to a combination of encouragement and food availability and accessibility. This food parenting practice was therefore be included in encouragement as well as food availability and accessibility.

**** Study also focused on control which referred to a combination of rules and limits (i.e., structure) and overt control (i.e., coercive control). Therefore, this food parenting practice was not included in this review.

Coercive Control

Restriction. Restriction refers to parent-centered, authoritarian forms to limit children's (unhealthy) food intake [12]. In total, 23 studies (based on 20 unique datasets) examined the association between restriction and child weight outcome. One study examined also a restrictive form of monitoring. Eight out of 23 studies reported a significant association between restriction and weight outcome in either the total or a subsample. Two studies (based on two datasets) reported that higher levels of restriction preceded higher weight outcomes [40, 43]. Three studies (based on two datasets) found similar positive associations as well as null-associations, depending on child inhibitory control or maternal (pre-pregnancy) weight status [22, 32, 34]. In contrast, two studies (based on two independent datasets) reported both inverse and null-associations, depending on the reporter of restriction (i.e., self-report vs. observed) or child age [24, 26]. One study reported positive, inverse as well as non-significant associations between restriction and weight outcome, depending on specific weight outcome (i.e., *z*BMI or WHtR), parent and child gender, and which measurement waves were analyzed [56]. Thus, the majority of studies (n = 15 out of 23) found no prospective relation between restriction and child weight outcome. A potential positive or inverse association may only exist for specific subpopulations.

Pressure to eat. Pressure to eat refers to demanding the child to eat more, without taking child's hunger, satiation or food preference into account [12]. Seventeen studies (based on 15 independent datasets) focused on pressure to eat in association with weight outcome. Five out of 17 studies reported a significant association of pressure to eat with weight outcome for either the total or a subsample. One study found that more pressure to eat was associated with a larger increase in *z*BMI [47], but was based on the same dataset as a study reporting null-findings for this association [24]. One study provided support for more pressure to eat being associated with lower *z*BMI [19]. Three studies (all based on different datasets)

reported inverse as well as non-significant associations between pressure to eat and weight, depending on maternal pre-pregnancy weight or parent and child gender and which measurement waves were analyzed [32, 41, 56]. In conclusion, most studies (n = 12 out of 17) suggested that pressure to eat was not associated with future weight outcome. A potential inverse association may only exist for a specific subpopulation.

Instrumental and emotional feeding[3]. Instrumental feeding reflects parents' use of food to control children's behavior, and emotional feeding reflects to parents' use of food to calm the child when, for example, upset, angry or hurt [12]. In total six studies (based on six independent datasets) examined instrumental and/or emotional feeding in association with weight outcome. Two studies focused on instrumental and emotional feeding combined, two studies on instrumental and emotional feeding separately, and two studies on emotional feeding only. Regarding instrumental and emotional feeding combined, both studies reported non-significant associations with weight outcome [20, 56]. All four studies assessing associations between emotional feeding and weight outcome also reported null-findings [29, 44, 50, 51]. In contrast, both studies focusing on instrumental feeding indicated that more instrumental feeding was associated with higher (increase in) zBMI at over time [50, 51]. In conclusion, results suggest that more instrumental feeding, but not emotional feeding or instrumental and emotional feeding combined, may precede unhealthier weight outcomes.

Overt control[4]. Overt control refers to controlling parenting practices that can be detected by the child (e.g., parents decide when, what and how much the child eats) [59]. One

[3] Vaughn and colleagues [12] named these food parenting practices "Threats and bribes" (i.e., instrumental feeding) and "Using food to control negative emotions" (i.e., emotional feeding). Since instrumental and emotional feeding are more likely to be used within the literature, we decided to use this terminology.

[4] This food parenting practice is not explicitly included in the conceptual framework of Vaughn and colleagues [12], but is measured by combining restriction and pressure to eat.

study examined the prospective association of overt control with children's weight outcome, finding that higher levels of overt control were associated with lower zBMI over time.

Structure

Monitoring. Monitoring refers to keeping track of what a child eats and drinks [12]. Eleven studies (based on 11 unique datasets), investigated the prospective association of monitoring with weight outcome. Three out of 11 studies reported a significant association between monitoring and weight outcome in either the total or a subsample. One study reported that more monitoring was associated with lower weight outcomes over time [40]. One other study reported similar inverse associations as well as null-associations of monitoring with weight outcome, depending on maternal pre-pregnancy weight [32]. Lastly, one study reported positive, inverse as well as non-significant associations, depending on parenting style [57]. In conclusion, most studies (n = 8 out of 11) found no prospective link between monitoring and weight outcome. A potential inverse association may only exist for a specific subpopulation.

Meal routines. Meal routines reflect the structure and predictability parents create around meal occasions [12]. This can include the frequency that meals are eaten together with the family, timing of the meals, and rules during meals. In total, ten studies (based on six unique datasets) examined associations of meal and snack routines with weight outcome. Nine studies (based on five unique datasets) focused on frequency of family meals (i.e., meals in general, n = 6; dinner, n = 2; dinner and breakfast, n = 1), with one also focusing on mealtime rules. One study focused on mealtime regularity.

Regarding frequency of family meals, five out of nine studies reported a significant prospective link with weight outcome in either the total or a subsample. Three studies provided support for having more frequent family meals or dinner being associated with lower weight [23, 37, 53]. One study indicated that higher frequency of family breakfast—but not

dinner—was associated with lower weight outcomes [27]. Another study found that more frequent family meals were associated with higher weight outcomes, but only for a subgroup depending on ethnicity, acculturation and parental control [28]. It should be noted, however, that two datasets were used in multiple studies (i.e., dataset 1: [23, 36, 46]; dataset 2: [27, 28, 37]), and results of these studies were mixed. For example, while one study found that having more frequent family meals was associated with higher weight outcomes for a particular subpopulation [28], two other studies found that having more frequent family meals [37] or breakfast (but not dinner) [27] was associated with lower weight outcomes in the total sample. In conclusion, there is a large heterogeneity in results between studies—even those based on the same dataset. An association between meal frequency and weight outcome is therefore equivocal.

Only one study focused on mealtime rules and found that having more rules was associated with lower *z*BMI (but not WHtR) over time [42]. Only one study focused on mealtime regularity and found that not always having a regular mealtime (compared to always having a regular mealtime) was associated with lower odds for obesity [21].

Food availability and accessibility. Food availability refers to the food parents bring or do not bring into the homes, and food accessibility reflects how easily children can get access to these foods [12]. Seven studies (based on six independent datasets) assessed associations of food availability and accessibility with weight outcome: three studies focused on covert control (i.e., control over the food environment), two studies (based on one dataset) focused on availability of (un)healthy foods, one study on offering fruits and vegetables, and one study on stimulation of healthy food intake. Two out of seven studies found a significant association. One study found that more stimulation of healthy eating preceded a lower *z*BMI two years later. Another study suggested that more covert control was linked with higher *z*BMI at follow-up [39]. Thus, most (n = 5 out of 7) studies did not find a prospective link of

food availability and accessibility with weight outcome. However, results should be interpreted with caution, as most studies focused on only a small aspect of food availability and accessibility.

Unstructured practices. Unstructured practices reflect a lack of structure and parental control around child's eating [12]. In total, four studies (based on four unique datasets) examined the association of unstructured practices with weight outcome. Two out of four studies indicated that among boys (but not girls) unstructured practices were associated with higher (change in) *z*BMI [30, 49]. The remaining two studies did not find significant associations between unstructured practices and weight outcome [43, 44]. In conclusion, results suggest that unstructured practices might be associated with higher weight outcome, but only among boys.

Rules and limits. Rules and limits refer to providing expectations and boundaries regarding when, where, what and how much a child should eat [12]. Two studies (based on two unique datasets) assessed whether rules and limits were associated with weight outcome overt time, and both studies did not find significant associations [35, 50].

Modeling of healthy eating. Modeling of healthy eating refers to parents' engagement in healthy eating in the presence of their child [12]. One study focused on modeling of healthy eating, finding no association between modeling and *z*BMI [38].

Limited or guided choices. Limited or guided choices involves giving children control over what they eat, appropriate for their age and developmental stage [12]. One study focused on limited or guided choices, and found that more parental food-choice control at age 3.5 was associated with lower weight outcomes at age 15, but not at age 7.

Autonomy Support

Encouragement. Encouragement refers to stimulating children to eat healthy and develop healthy eating habits in a non-directive way [12]. Four studies (based on four unique

datasets) examined how encouragement was associated with weight outcome over time. One study found that stimulation of healthy food intake was associated with a lower *z*BMI at follow-up [39]. In contrast, another study reported positive and null-associations between encouragement and weight outcome, depending on specific weight outcome (i.e., BMI and WHtR), parent and child gender, and which measurement waves were analyzed [56]. The remaining two studies reported null-findings [44, 50]. Thus, results regarding the prospective link of encouragement with weigh outcome are mixed and rather inconclusive.

Moderator analyses

In total, 23 studies examined moderators or performed stratified analyses. Table 3 shows which moderators and stratifications were used within these studies. Below will be elaborated on moderators and stratifications that were assessed in at least two studies.

Table 3

Moderators and Stratification Used in the Included Studies

Moderator	*N*	Significant
Child gender	12	3
Child baseline weight (status)	5	0
Age group	4	1
Race/Ethnicity	4	3
Maternal (pre-pregnancy) weight status	3	2
General parenting	3	2
Child inhibitory control	1	1
Acculturation	1	1
Parent gender	1	1
Birth weight	1	0
Hungry eating style	1	0
Picky eating style	1	0
Activity styles	1	0
Maltreatment	1	0
Maternal baseline unstructured practices	1	0
Child approach	1	0

Child gender. Twelve studies used child gender as moderator or stratified analyses by gender. The majority of studies (n = 9) did not find gender differences on the association between food parenting practices and weight outcome (i.e., restriction, n = 4; monitoring, n = 3; frequency of family meals, n = 3; pressure to eat, n = 2; rules and limits, n = 1; food availability and accessibility, n = 1; stimulation (i.e., combination of food availability/accessibility and encouragement), n = 1) [23, 31, 32, 35, 36, 39, 48, 55, 58]. One study found that paternal (but not maternal) restriction at T2 preceded higher WHtR at T3 for boys, but lower WHtR at T3 for girls. Maternal and paternal pressure to eat at T1 preceded lower WHtR at T2 for boys only. Similarly, paternal encouragement at T2 preceded higher WHtR at T3 for boys only. Associations of instrumental and emotional feeding with weight outcome were not different for boys and girls [56]. Notably, two studies examined gender differences on the association between unstructured practices and weight outcome. Both studies found that only for boys more unstructured practices were associated with higher weight outcomes [30, 49]. Thus, these results suggest that unstructured practices may only among boys precede unhealthier weight outcomes. For other food parenting practices (convincing) gender differences were not found.

Child baseline weight (status). Five studies used child baseline weight (status) as a moderator or stratification. All five studies found that child baseline weight status did not moderate associations of food parenting practices with weight outcome (i.e., restriction, n = 3; pressure to eat, n = 1; monitoring, n = 1; frequency of family meals, n = 1; food availability and accessibility, n = 1; stimulation (i.e., combination of food availability/accessibility and encouragement), n = 1) [23, 31, 33, 39, 49]. Thus, results provide support for no moderating effect of child baseline weight (status) on the link between food parenting practices and children's weight outcome.

Age group. Four studies stratified results by age group or used age group as a moderator. One study included preschoolers and schoolagers and found significant age differences: more restriction was significantly associated with healthier weight outcomes among preschoolers, but not schoolagers [26]. Other studies (three out of four) included schoolagers and adolescents and all focused on the association between frequency of family meals with weight outcome. These studies did not find age-related differences [23, 36, 55]. In sum, results suggest no differences between schoolagers and adolescents regarding the link of food parenting practices and weight outcome. More research is needed to assess whether differences occur between preschoolers and schoolagers/adolescents.

Race/ethnicity. Three out of four studies found significant racial/ethnic differences on the association of food parenting practices and weight outcome. All three studies focused on frequency of family meals. A first study found that for black adolescents only having more frequent family meals was associated with a decreased likelihood for obesity. No racial/ethnic differences were found regarding the inverse association of frequency of family meals with overweight [23]. A second study found that having more frequent family meals was associated with higher weight outcomes only among Hispanic adolescents (compared to white/non-Hispanic adolescents) from less acculturated families with lower parental control [28]. A third study found that only among non-Hispanic white adolescents having more frequent family meals was associated with lower odds for moving into overweight. No racial/ethnic differences were found regarding the positive association of frequency of family meals with ceasing to be overweight [53]. Lastly, one study focused on restriction, pressure to eat and monitoring, and found no evidence for race/ethnicity as a moderator on the link of food parenting practices and weight outcome [54]. Thus, racial/ethnic differences may exist in the association between particularly frequency of family meals and weight outcome, but it is

yet unclear for which races/ethnicities a higher frequency of family meals is more (dis)advantageous.

Maternal (pre-pregnancy) weight status. Two out of three studies examining maternal weight status as a moderator found significant differences. More restriction was associated with higher weight outcomes among mothers with higher weight status only [32, 34], pressure to eat was associated with lower weight outcomes among mothers with higher weight status only, and monitoring was associated with lower weight outcomes among mothers with lower weight status only [32]. One study did not report significant differences in the association of unstructured practices and weight status [49]. Thus, results provide preliminary support for maternal weight status moderating the association between food parenting practices and weight outcome. The adverse link between coercive controlling food parenting practices and children's weight may be stronger for mothers with a higher weight, and the favorable link between monitoring and children's weight may be weaker for mothers with a higher weight.

General parenting. Two out of three studies assessing parenting style as a moderator or stratification found significant differences. A first study found that more monitoring was associated with an increased likelihood for overweight among more authoritarian mothers and a decreased likelihood for overweight among more authoritative mothers. However, parenting style did not moderate the associations of restriction and pressure to eat with weight outcome [57]. A second study found that having more frequent family meals was associated with unhealthier weight outcomes only among Hispanic adolescents (compared to white/non-Hispanic adolescents) from less acculturated families with lower parental control [28]. However, another study found that parenting style did not moderate the associations of food parenting practices (i.e., rules and limits, emotional feeding, instrumental feeding, food availability and accessibility, encouragement) with weight outcome [50]. Thus, results

provide preliminary support that general parenting modulates the prospective link of some food parenting practices (i.e., monitoring, frequency of family meals) with child weight.

Discussion

The current systematic review aimed to provide an overview of the prospective link of different food parenting practices with children's weight outcome. In total, 40 studies were included in this review, focusing on 12 different food parenting constructs. Restriction, pressure to eat and monitoring were not associated with children's weight over time. Also most studies on food availability and accessibility found no prospective link with weight outcome, but studies often focused on only a small aspect of these food parenting practices. Findings related to emotional and instrumental feeding indicated that instrumental—but not emotional—feeding was associated with higher weight outcomes. Regarding frequency of mealtimes (an aspect of meal routines), results were mixed. Lastly, findings related to other structure-related (e.g., rules and limits, modeling of healthy eating) and autonomy supporting (e.g., encouragement) food parenting practices were insufficient (i.e., understudied).

Prospective associations of food parenting practices with weight outcome

Prospective associations of restriction, pressure to eat, and monitoring with children's weight outcome were most frequently and consistently examined, strengthening the conclusions regarding these associations. Most studies found no link between these food parenting practices and children's weight development. In contrast to these findings, previous systematic reviews (including primarily cross-sectional studies) found that more restriction was associated with higher child BMI, and more pressure to eat to with lower child BMI [15, 16]. It has been suggested that parents and children mutually influence each other's behavior around eating [8]. Notably, among studies examining bidirectional associations, the link from *z*BMI to restriction and pressure to eat was oftentimes stronger than the link from these food parenting practices to *z*BMI [19, 31, 41, 56, 58]. Findings from this review suggest that,

overall, parents do not influence their children's weight via restriction and pressure to eat. Rather, parents may primarily adjust their levels of restriction and pressure to eat to children's weight (e.g., using restriction *because* the child is overweight; using pressure to eat *because* the child is underweight).

While previous reviews consistently showed that higher availability and accessibility of (un)healthy foods was associated with higher intake of these food products [13, 60-62], the present review does not find support for a prospective link of food availability and accessibility with children's weight. However, these findings should be interpreted cautiously, as studies often focused on a small aspect of food availability and accessibility (e.g., covert control). Thus, it may be that a significant association was not found, as important features of availability and accessibility were not fully captured. Further, it might be that food availability and accessibility influence children's dietary intake, but not enough to uniquely contribute to children's weight development for the general population. However, these food parenting practices may matter for specific subpopulations. For example, it has suggested that the link between the (food) environment and childhood obesity is modulated by children's genetic makeup [63]. Particularly children with a genetic predisposition for obesity may be at risk of gaining weight within an unhealthy food environment. Further research is needed assess whether genetic makeup related to obesity modulates the association of food availability and accessibility with weight outcome.

Studies included in this review consistently found that instrumental feeding was associated with higher weight, whereas emotionally feeding was not associated with children's weight over time. Although limited due to the small number of relevant studies, these findings indicate the importance of disentangling instrumental and emotional feeding when assessing their prospective association with weight outcome. In line with findings of the present review, a previous systematic review and meta-analysis found that instrumental

feeding was associated with more unhealthy eating [60]. As unhealthy foods are usually high calorie food products, instrumental feeding may result in increased energy intake and weight gain over time. Regarding emotional feeding, it has been proposed that children whose parents regularly use this practice may learn to calm themselves by eating, which may promote unhealthy weight development [64]. While previous longitudinal [50] and experimental [65] research found that emotional feeding negatively influenced eating behavior (e.g., higher snack intake), findings from this review suggest no link of emotional feeding with weight over time. It is yet unclear why instrumental and emotional feeding are both linked with increased unhealthy food intake, but only instrumental feeding with higher weight over time. Though speculative, it may be that instrumental feeding occurs more frequently than emotional feeding, and that only increased caloric intake due to instrumental feeding is sufficient to induce weight gain. Besides, generalizability of experimental studies on eating behavior are limited, and longitudinal studies generally rely on parent or self-report questionnaires to measure food intake, which are often not accurate [66]. Thus, it is questionable whether a positive link between emotional feeding and caloric intake—the basis for a positive link of emotional feeding with weight outcome—indeed exists.

Regarding meal and snack routines, results of associations between frequency of family meals with weight outcome were mixed—even across studies using the same dataset. One potential explanation for this inconsistency could be that studies differed in how they analyzed the data (e.g., different outcome measures, covariates). Associations of food parenting practices and children's eating behavior or weight are likely bidirectional, with many factors moderating this association. Thus, the right question to ask may be *for whom* frequency of family meals is associated with (un)healthier weight outcomes, rather than *whether* there is an association. For instance, all studies assessing the moderating role of race/ethnicity on the link of frequency of family meals with weight outcome suggested

racial/ethnic differences. Associations may differ across races/ethics, because of cultural differences in parenting and eating patterns (e.g., [67, 68]). For which races/ethnicities a higher frequency of family meals is more (dis)advantageous, is yet unclear.

Other structure-related and autonomy supporting food parenting practices (i.e., mealtime regularity, mealtime rules, unstructured practices, rules and limits, modeling of healthy eating, limited and guided choices, and encouragement) have received very little attention within prospective studies. Moreover, studies used inconsistent and often non-validated measures to assess these food parenting practices. It is therefore not possible to draw firm conclusions regarding the prospective links of these food parenting practices with weight outcome. Interestingly, though, two studies assessed gender differences on the link between unstructured practices and weight outcome, and both found that among boys—but not girls—more unstructured practices were associated with higher weight outcomes. Previous research suggested that boys may work harder for (food) rewards than girls [69, 70]. These efforts might particularly bear fruit when parents show more unstructured food parenting practices, resulting in higher caloric intake and consequently weight gain. Therefore, boys may need more parental structure (e.g., rules and limits) than girls. Future research should further examine gender differences on the prospective link between structure-related food parenting practices and children's weight outcome.

Lastly, one study combined measures of restriction and pressure to eat into one food parenting practice: overt control. However, restriction and pressure to eat are used for opposite reasons. Parents may namely pressure their child to eat if they are afraid that the child does not eat enough, but use restriction if they are afraid the child eats too much (of unhealthy foods). Moreover, in cross-sectional studies, restriction and pressure to eat were associated with weight outcome in the opposite direction [15, 16]. Combining these food parenting practices is therefore not appropriate.

Opportunities for future research

This review has identified several opportunities to improve future research. First, research should focus on a larger variety or clusters of food parenting practices. Many structure-related and autonomy supporting food parenting practices—which theoretically may have a beneficial influence on children's eating behavior and weight—received little (e.g., mealtime rules, guided and limited choices [12]) or no (e.g., food preparation [12]) attention in prospective studies. Further prospective research towards these food parenting practices is needed to find out whether they indeed should be stimulated among parents. Besides, food parenting practices are often assessed in isolation, whereas parents are more likely to use combinations of food parenting practices (e.g., encouragement and healthy modeling) to influence their children's eating behavior [71, 72]. The use of one food parenting practice may also influence the need for other food parenting practices. For example, the amount of snack food parents bring to the home may influence to what extend they have to limit children's snack intake [12]. Exploring clusters of food parenting practices may provide a more nuanced picture of how food parenting practices are associated with weight over time.

Second, measurements of food parenting practices should be improved. Many structure-related and autonomy supporting food parenting practices were assessed using divergent and often non-validated measures. For some food parenting practices validated measures may not yet be available. Future research should therefore invest in developing and validating questionnaires assessing a larger variety of structure-related and autonomy supporting food parenting practices [12]. Next to that, the majority of studies relied on parent-report questionnaires only to measure food parenting practices. While parents may use some food parenting practices consciously, other food parenting practices may be used unconsciously. Parent-report measures may therefore not be accurate. Bergmeier and colleagues [24], for example, found discrepancies between reported and observed levels of

restriction, and their prospective link with weight outcome. To reduce bias and gain a better understanding of the relation between food parenting practices and children's weight, future research should (additionally) use observation or child-report questionnaires (for schoolagers/adolescents) to measure food parenting practices.

Third, future studies should explore parent, child and context characteristics that may modify the link of food parenting practices with weight outcome. In addition to race/ethnicity and gender—as discussed earlier—child age, parent gender, parental weight status and general parenting should receive more attention. Younger children (i.e., preschoolers) are more dependent on their parents than older children (i.e., schoolagers, adolescents). Therefore, parents may have a larger influence on younger children's eating behavior and weight. Further, while both fathers and mothers play a role in children's eating behavior and weight development, the majority of studies only focused on mothers. Not only the prospective link between father's food parenting practices and children's weight should receive more empirical attention [73], but also the degree of parental congruence [74]. For instance, rule and limit-setting may be more effective when both parents engage in this practice rather than only one parent [75]. Regarding parents' weight status, Larsen and colleagues [74] proposed that particularly parents with unhealthy eating patterns need positive food parenting practices to stimulate healthy eating in their children. Lastly, the link between food parenting practices and children's weight development may be modulated by general parenting—the emotional climate in which parenting practices occur [10]. Structure-related and autonomy supporting food parenting practices may yield more beneficial effects on children's behaviors within a positive compared to negative parenting context [8, 74, 76]. Parents having a positive parenting style may namely use more effective strategies to control their children's behavior, and their children may be more likely to behave as expected from them [77]. The current systematic review provides some support for child age, parent gender,

maternal weight status and general parenting modulating the link between food parenting practices and children's weight outcome. However, only few studies assessed these factors are moderators. More research towards these moderating effects is therefore needed.

Fourth, it is recommended to asses bidirectional associations between food parenting practices and children's weight over time. Within the food parenting literature, most studies focused on potential parental influences on children's weight outcome, without taking reciprocal associations into account [8]. Few studies included in this review did examine bidirectional associations [19, 31, 41, 43, 44, 49, 56, 58]. Most of these studies suggested that future food parenting practices may be a reaction to children's weight [19, 31, 41, 43, 49, 56, 58]. Investigating bidirectional associations is crucial to further disentangle the directionality of the link between food parenting practices and children's weight.

Strengths and limitations

The present systematic review had several strengths. First, to promote transparency and increase replicability of our results, we preregistered the review, used the PRISMA protocol and provided a detailed search strategy. Second, to reduce bias during the selection process, all titles, abstracts and full-texts were double screened by two independent reviewers. Third, in contrast to previous systematic reviews, we solely focused on prospective studies. This review therefore increases our insight into the directionality in the associations of food parenting practices and children's weight outcome. Fourth, we used the conceptual framework of Vaughn and colleagues [12] to organize the food parenting practices, thereby contributing to more consistency in terminology within the literature.

Besides these strengths, several limitations should be acknowledged. First, we did not include grey literature. Including grey literature would have resulted in a more comprehensive set of studies, providing a better picture of the evidence regarding the prospective relations of food parenting practices with child weight outcome. However, as particularly null-findings

are less likely to be published [78] and the majority of included studies reported null-findings, it seems unlikely that our conclusions would drastically change when including grey literature. Second, most studies were conducted among Western populations. Since cultural differences may exists in parenting and eating patterns (e.g., [67, 68]), current results may not be generalizable to non-Western societies. Third, many studies did not meet key quality criteria, particularly adjusting for key potential confounders and/or using validated measure to assess food parenting practices. Moreover, none of the studies provided a sample size justification. While smaller studies might not have had enough power to identify all existing effects (e.g., [24, 32]), for larger studies it is questionable whether identified effects are meaningful (e.g., [21]). These methodological shortcomings also limit the conclusions of the present systematic review. Future research should therefore overcome these shortcomings.

Conclusion

To conclude, this systematic review is the first review providing an overview of the prospective link between food parenting practices and children's weight outcome. Restriction, pressure to eat, and monitoring were assessed most often, but were not associated with children's weight over time. Further, instrumental—but not emotional—feeding may precede higher weight outcomes, indicating that associations of these food parenting practices with weight outcome should be assessed separately. This review identified important gaps within the literature that should be addressed in future research. To obtain a more complete and nuanced picture of the prospective relationship between food parenting practices and children's weight outcome, research should focus more on structure-related and autonomy supporting parenting practices, and invest in developing and validating instruments to assess these food parenting practices. Additionally, research should examine potential moderators of the link between food parenting practices and weight outcome, and investigate bidirectional rather that unidirectional associations.

References

1. NCD Risk Factor Collaboration. (2017). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: A pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults. *The Lancet, 390*, 2627-2642. doi:10.1016/s0140-6736(17)32129-3
2. Kumar, S., & Kelly, A. S. (2017). Review of childhood obesity: From epidemiology, etiology, and comorbidities to clinical assessment and treatment. *Mayo Clinic Proceedings, 92*, 251-265. doi:10.1016/j.mayocp.2016.09.017
3. Weihrauch-Blüher, S., Schwarz, P., & Klusmann, J. H. (2019). Childhood obesity: Increased risk for cardiometabolic disease and cancer in adulthood. *Metabolism, 92*, 147-152. doi:10.1016/j.metabol.2018.12.001
4. Simmonds, M., Llewellyn, A., Owen, C. G., & Woolacott, N. (2016). Predicting adult obesity from childhood obesity: A systematic review and meta-analysis. *Obesity Reviews, 17*, 95-107. doi:10.1111/obr.12334
5. Garrow, S. J. (1988). *Obesity and related diseases*. London: Churchill Livingstone.
6. Hill, J. O., Wyatt, H. R., & Peters, J. C. (2012). Energy balance and obesity. *Circulation, 126*, 126-132. doi:10.1161/CIRCULATIONAHA.111.087213
7. Larson, N., & Story, M. (2009). A review of environmental influences on food choices. *Annals of Behavioral Medicine, 38*, S56-73. doi:10.1007/s12160-009-9120-9
8. Niermann, C. Y. N., Gerards, S. M. P. L., & Kremers, S. P. J. (2018). Conceptualizing family influences on children's energy balance-related behaviors: Levels of interacting family environmental subsystems (The LIFES Framework). *International Journal of Environmental Research and Public Health, 15*. doi:10.3390/ijerph15122714
9. Gicevic, S., Aftosmes-Tobio, A., Manganello, J. A., Ganter, C., Simon, C. L., Newlan, S., & Davison, K. K. (2016). Parenting and childhood obesity research: a quantitative

content analysis of published research 2009-2015. *Obesity Reviews, 17*, 724-734. doi:10.1111/obr.12416

10. Darling, N., & Steinberg, L. (1993). Parenting style as context: An integrative model. *Psychological Bulletin, 113*, 487-496. doi:10.1037/0033-2909.113.3.487
11. O'Connor, T. M., Mâsse, L. C., Tu, A. W., Watts, A. W., Hughes, S. O., Beauchamp, M. R., . . . Vaughn, A. (2017). Food parenting practices for 5 to 12 year old children: a concept map analysis of parenting and nutrition experts input. *International Journal of Behavioral Nutrition Physical Activity, 14*, 122. doi:10.1186/s12966-017-0572-1
12. Vaughn, A. E., Ward, D. S., Fisher, J. O., Faith, M. S., Hughes, S. O., Kremers, S. P. J., . . . Power, T. G. (2016). Fundamental constructs in food parenting practices: A content map to guide future research. *Nutrition Reviews, 74*, 98-117. doi:10.1093/nutrit/nuv061
13. DeCosta, P., Møller, P., Frøst, M. B., & Olsen, A. (2017). Changing children's eating behaviour - A review of experimental research. *Appetite, 113*, 327-357. doi:10.1016/j.appet.2017.03.004
14. Nekitsing, C., Blundell-Birtill, P., Cockroft, J. E., & Hetherington, M. M. (2018). Systematic review and meta-analysis of strategies to increase vegetable consumption in preschool children aged 2-5 years. *Appetite, 127*, 138-154. doi:10.1016/j.appet.2018.04.019
15. Hurley, K. M., Cross, M. B., & Hughes, S. O. (2011). A systematic review of responsive feeding and child obesity in high-income countries. *The Journal of Nutrition, 141*, 495-501. doi:10.3945/jn.110.130047
16. Shloim, N., Edelson, L. R., Martin, N., & Hetherington, M. M. (2015). Parenting styles, feeding styles, feeding practices, and weight status in 4-12 year-old children: A

systematic review of the literature. *Frontiers in Psychology, 6*. doi:10.3389/fpsyg.2015.01849

17. Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gotzsche, P. C., Ioannidis, J. P. A., . . . Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *Plos Medicine, 6*. doi:10.1371/journal.pmed.1000100
18. National Heart Lung and Blood Institute. (2014). *Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies.* Retrieved from https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools
19. Afonso, L., Lopes, C., Severo, M., Santos, S., Real, H., Durao, C., . . . Oliveira, A. (2016). Bidirectional association between parental child-feeding practices and body mass index at 4 and 7 y of age. *The American Journal of Clinical Nutrition, 103*, 861-867. doi:10.3945/ajcn.115.120824
20. Agras, W. S., Hammer, L. D., McNicholas, F., & Kraemer, H. C. (2004). Risk factors for childhood overweight: A prospective study from birth to 9.5 years. *The Journal of Pediatrics, 145*, 20-25. doi:10.1016/j.jpeds.2004.03.023
21. Anderson, S. E., Sacker, A., Whitaker, R. C., & Kelly, Y. (2017). Self-regulation and household routines at age three and obesity at age eleven: Longitudinal analysis of the UK Millennium Cohort Study. *International Journal of Obesity, 41*, 1459-1466. doi:10.1038/ijo.2017.94
22. Anzman, S. L., & Birch, L. L. (2009). Low inhibitory control and restrictive feeding practices predict weight outcomes. *The Journal of Pediatrics, 155*, 651-656. doi:10.1016/j.jpeds.2009.04.052
23. Berge, J. M., Wall, M., Hsueh, T.-F., Fulkerson, J. A., Larson, N., & Neumark-Sztainer, D. (2015). The protective role of family meals for youth obesity: 10-year

longitudinal associations. *The Journal of Pediatrics, 166*, 296-301. doi:10.1016/j.jpeds.2014.08.030

24. Bergmeier, H., Skouteris, H., Haycraft, E., Haines, J., & Hooley, M. (2015). Reported and observed controlling feeding practices predict child eating behavior after 12 months. *The Journal of Nutrition, 145*, 1311-1316. doi:10.3945/jn.114.206268
25. Bergmeier, H., Skouteris, H., Horwood, S., Hooley, M., & Richardson, B. (2014). Child temperament and maternal predictors of preschool children's eating and body mass index. A prospective study. *Appetite, 74*, 125-132. doi:10.1016/j.appet.2013.12.006
26. Campbell, K., Andrianopoulos, N., Hesketh, K., Ball, K., Crawford, D., Brennan, L., . . . Timperio, A. (2010). Parental use of restrictive feeding practices and child BMI z-score. A 3-year prospective cohort study. *Appetite, 55*, 84-88. doi:10.1016/j.appet.2010.04.006
27. Chang, Y., & Gable, S. (2013). Predicting weight status stability and change from fifth grade to eighth grade: The significant role of adolescents' social-emotional well-being. *The Journal of Adolescent Health, 52*, 448-455. doi:10.1016/j.jadohealth.2012.09.005
28. Chang, Y., & Halgunseth, L. C. (2015). The association between family meals and early-adolescents' weight status change in the context of parental discipline practices: the moderating roles of ethnicity and acculturation. *Journal of Immigrant and Minority Health, 17*, 450-458. doi:10.1007/s10903-014-0084-x
29. Chong, S. Y., Chittleborough, C. R., Gregory, T., Lynch, J. W., Mittinty, M. N., & Smithers, L. G. (2017). Associations of parental food-choice control and use of food to soothe with adiposity in childhood and adolescence. *Appetite, 113*, 71-77. doi:10.1016/j.appet.2017.02.018

30. Crossman, A., Anne Sullivan, D., & Benin, M. (2006). The family environment and American adolescents' risk of obesity as young adults. *Social Science & Medicine, 63*, 2255-2267. doi:10.1016/j.socscimed.2006.05.027

31. Derks, I. P. M., Tiemeier, H., Sijbrands, E. J. G., Nicholson, J. M., Voortman, T., Verhulst, F. C., . . . Jansen, P. W. (2017). Testing the direction of effects between child body composition and restrictive feeding practices: Results from a population-based cohort. *American Journal of Clinical Nutrition, 106*, 783-790. doi:10.3945/ajcn.117.156448

32. Faith, M. S., Berkowitz, R. I., Stallings, V. A., Kerns, J., Storey, M., & Stunkard, A. J. (2004). Parental feeding attitudes and styles and child body mass index: Prospective analysis of a gene-environment interaction. *Pediatrics, 114*, E429-E436. doi:10.1542/peds.2003-1075-L

33. Faith, M. S., Dennison, B. A., Edmunds, L. S., & Stratton, H. H. (2006). Fruit juice intake predicts increased adiposity gain in children from low-income families: Weight status-by-environment interaction. *Pediatrics, 118*, 2066-2075. doi:10.1542/peds.2006-1117

34. Francis, L., & Birch, L. (2005). Maternal weight status modulates the effects of restriction on daughters' eating and weight. *International Journal of Obesity, 29*, 942-949. doi:10.1038/sj.ijo.0802935

35. Fulkerson, J. A., Hannan, P., Rock, B. H., Smyth, M., Himes, J. H., & Story, M. (2013). Food responsiveness, parental food control and anthropometric outcomes among young American Indian children: Cross-sectional and prospective findings. *Ethnicity & Disease, 23*, 136-142.

36. Fulkerson, J. A., Neumark-Sztainer, D., Hannan, P. J., & Story, M. (2008). Family meal frequency and weight status among adolescents: Cross-sectional and 5-year longitudinal associations. *Obesity, 16*, 2529-2534. doi:10.1038/oby.2008.388

37. Gable, S., Chang, Y., & Krull, J. L. (2007). Television watching and frequency of family meals are predictive of overweight onset and persistence in a national sample of school-aged children. *Journal of the American Dietetic Association, 107*, 53-61. doi:10.1016/j.jada.2006.10.010

38. Gregory, J. E., Paxton, S. J., & Brozovic, A. M. (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*. doi:10.1186/1479-5868-7-55

39. Gubbels, J. S., Kremers, S. P., Stafleu, A., de Vries, S. I., Goldbohm, R. A., Dagnelie, P. C., . . . Thijs, C. (2011). Association between parenting practices and children's dietary intake, activity behavior and development of body mass index: The KOALA Birth Cohort Study. *The International Journal of Behavioral Nutrition and Physical Activity, 8*, 18. doi:10.1186/1479-5868-8-18

40. Hughes, S. O., Power, T. G., O'Connor, T. M., Fisher, J. O., & Chen, T. A. (2016). Maternal feeding styles and food parenting practices as predictors of longitudinal changes in weight status in Hispanic preschoolers from low-income families. *Journal of Obesity*. doi:10.1155/2016/7201082

41. Jansen, P. W., Tharner, A., van der Ende, J., Wake, M., Raat, H., Hofman, A., . . . Tiemeier, H. (2014). Feeding practices and child weight: is the association bidirectional in preschool children? *American Journal of Clinical Nutrition, 100*, 1329-1336. doi:10.3945/ajcn.114.088922

42. Lehto, R., Ray, C., & Roos, E. (2012). Longitudinal associations between family characteristics and measures of childhood obesity. *International Journal of Public Health, 57*, 495-503. doi:10.1007/s00038-011-0281-5

43. Liszewska, N., Scholz, U., Radtke, T., Horodyska, K., & Luszczynska, A. (2018). Bi-directional associations between parental feeding practices and children's body mass in parent-child dyads. *Appetite, 129*, 192-197. doi:10.1016/j.appet.2018.07.011

44. Lumeng, J. C., Kaciroti, N., Retzloff, L., Rosenblum, K., & Miller, A. L. (2017). Longitudinal associations between maternal feeding and overweight in low-income toddlers. *Appetite, 113*, 23-29. doi:10.1016/j.appet.2017.02.016

45. Lumeng, J. C., Miller, A. L., Appugliese, D., Rosenblum, K., & Kaciroti, N. (2018). Picky eating, pressuring feeding, and growth in toddlers. *Appetite, 123*, 299-305. doi:10.1016/j.appet.2017.12.020

46. Mason, S. M., Santaularia, N. J., Berge, J. M., Larson, N., & Neumark-Sztainer, D. (2018). Is the childhood home food environment a confounder of the association between child maltreatment exposure and adult body mass index? *Preventive Medicine, 110*, 86-92. doi:10.1016/j.ypmed.2018.02.016

47. McPhie, S., Skouteris, H., Fuller-Tyszkiewicz, M., McCabe, M., Ricciardelli, L. A., Milgrom, J., . . . Dell'Aquila, D. (2012). Maternal predictors of preschool child-eating behaviours, food intake and body mass index: A prospective study. *Early Child Development and Care, 182*, 999-1014. doi:10.1080/03004430.2012.678595

48. Quick, V., Wall, M., Larson, N., Haines, J., & Neumark-Sztainer, D. (2013). Personal, behavioral and socio-environmental predictors of overweight incidence in young adults: 10-yr longitudinal findings. *International Journal of Behavioral Nutrition and Physical Activity, 10*, 37. doi:10.1186/1479-5868-10-37

49. Rhee, K. E., Coleman, S. M., Appugliese, D. P., Kaciroti, N. A., Corwyn, R. F., Davidson, N. S., . . . Lumeng, J. C. (2009). Maternal feeding practices become more controlling after and not before excessive rates of weight gain. *Obesity, 17*, 1724-1729. doi:10.1038/oby.2009.54

50. Rodenburg, G., Kremers, S. P., Oenema, A., & van de Mheen, D. (2014). Associations of parental feeding styles with child snacking behaviour and weight in the context of general parenting. *Public Health Nutrition, 17*, 960-969. doi:10.1017/s1368980013000712

51. Rodgers, R. F., Paxton, S. J., Massey, R., Campbell, K. J., Wertheim, E. H., Skouteris, H., & Gibbons, K. (2013). Maternal feeding practices predict weight gain and obesogenic eating behaviors in young children: A prospective study. *International Journal of Behavioral Nutrition and Physical Activity, 10*. doi:10.1186/1479-5868-10-24

52. Rodgers, R. F., Paxton, S. J., McLean, S. A., Campbell, K. J., Wertheim, E. H., Skouteris, H., & Gibbons, K. (2013). Do maternal body dissatisfaction and dietary restraint predict weight gain in young pre-school children? A 1-year follow-up study. *Appetite, 67*, 30-36. doi:10.1016/j.appet.2013.03.009

53. Sen, B. (2006). Frequency of family dinner and adolescent body weight status: evidence from the national longitudinal survey of youth, 1997. *Obesity, 14*, 2266-2276. doi:10.1038/oby.2006.266

54. Spruijt-Metz, D., Li, C., Cohen, E., Birch, L., & Goran, M. (2006). Longitudinal influence of mother's child-feeding practices on adiposity in children. *The Journal of Pediatrics, 148*(3), 314-320. doi:10.1016/j.jpeds.2005.10.035

55. Taveras, E. M., Rifas-Shiman, S. L., Berkey, C. S., Rockett, H. R., Field, A. E., Frazier, A. L., . . . Gillman, M. W. (2005). Family dinner and adolescent overweight. *Obesity Reviews, 13*, 900-906. doi:10.1038/oby.2005.104

56. Tschann, J. M., Martinez, S. M., Penilla, C., Gregorich, S. E., Pasch, L. A., de Groat, C. L., . . . Butte, N. F. (2015). Parental feeding practices and child weight status in Mexican American families: A longitudinal analysis. *International Journal of Behavioral Nutrition and Physical Activity, 12*. doi:10.1186/s12966-015-0224-2

57. Tung, H. J., & Yeh, M. C. (2014). Parenting style and child-feeding behaviour in predicting children's weight status change in Taiwan. *Public Health Nutrition, 17*, 970-978. doi:10.1017/s1368980012005502

58. Webber, L., Cooke, L., Hill, C., & Wardle, J. (2010). Child adiposity and maternal feeding practices: A longitudinal analysis. *American Journal of Clinical Nutrition, 92*, 1423-1428. doi:10.3945/ajcn.2010.30112

59. Ogden, J., Reynolds, R., & Smith, A. (2006). Expanding the concept of parental control: A role for overt and covert control in children's snacking behaviour? *Appetite, 47*, 100-106. doi:doi.org/10.1016/j.appet.2006.03.330

60. Yee, A. Z., Lwin, M. O., & Ho, S. S. (2017). The influence of parental practices on child promotive and preventive food consumption behaviors: A systematic review and meta-analysis. *The International Journal of Behavioral Nutrition and Physical Activity, 14*. doi:10.1186/s12966-017-0501-3

61. Rasmussen, M., Krolner, R., Klepp, K. I., Lytle, L., Brug, J., Bere, E., & Due, P. (2006). Determinants of fruit and vegetable consumption among children and adolescents: A review of the literature. Part I: Quantitative studies. *International Journal of Behavioral Nutrition and Physical Activity, 3*. doi:10.1186/1479-5868-3-22

62. Blaine, R. E., Kachurak, A., Davison, K. K., Klabunde, R., & Fisher, J. O. (2017). Food parenting and child snacking: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 14*, 146. doi:10.1186/s12966-017-0593-9

63. Silventoinen, K., Rokholm, B., Kaprio, J., & Sorensen, T. A. (2010). The genetic and environmental influences on childhood obesity: a systematic review of twin and adoption studies. *International Journal of Obesity, 34*, 29-40. doi:10.1038/ijo.2009.177

64. Braden, A., Rhee, K., Peterson, C. B., Rydell, S. A., Zucker, N., & Boutelle, K. (2014). Associations between child emotional eating and general parenting style, feeding practices, and parent psychopathology. *Appetite, 80*, 35-40. doi:10.1016/j.appet.2014.04.017

65. Blissett, J., Haycraft, E., & Farrow, C. (2010). Inducing preschool children's emotional eating: relations with parental feeding practices. *American Journal of Clinical Nutrition, 92*, 359-365. doi:10.3945/ajcn.2010.29375

66. Johnson, R. K. (2002). Dietary intake--how do we measure what people are really eating? *Obesity Research, 10*, 63S-68S. doi:10.1038/oby.2002.192

67. Estima, C. C., Bruening, M., Hannan, P. J., Alvarenga, M. S., Leal, G. V., Philippi, S. T., & Neumark-Sztainer, D. (2014). A cross-cultural comparison of eating behaviors and home food environmental factors in adolescents from Sao Paulo (Brazil) and Saint Paul-Minneapolis (US). *Journal of Nutrition Education and Behavior, 46*, 370-375. doi:10.1016/j.jneb.2014.01.007

68. Darling, N., Cumsille, P., Pena-Alampay, L., & Coatsworth, D. (2009). Individual and Issue-Specific Differences in Parental Knowledge and Adolescent Disclosure in Chile, the Philippines, and the United States. *Journal of Research on Adolescence, 19*, 715-740. doi:10.1111/j.1532-7795.2009.00608.x

69. Rollins, B. Y., Loken, E., Savage, J. S., & Birch, L. L. (2014). Measurement of food reinforcement in preschool children. Associations with food intake, BMI, and reward sensitivity. *Appetite, 72*, 21-27. doi:10.1016/j.appet.2013.09.018

70. Chelonis, J. J., Gravelin, C. R., & Paule, M. G. (2011). Assessing motivation in children using a progressive ratio task. *Behavioural Processes, 87*, 203-209. doi:10.1016/j.beproc.2011.03.008

71. O'Connor, T. M., Hughes, S., Watson, K. B., Baranowski, T., Nicklas, T. A., Fisher, J. O., . . . Shewchuk, R. M. (2010). Parenting practices are associated with fruit and vegetable consumption in pre-school children. *Public Health Nutrition, 13*, 91-101. doi:10.1017/s1368980009005916

72. Gevers, D. W. M., Kremers, S. P. J., de Vries, N. K., & van Assema, P. (2015). Patterns of food parenting practices and children's intake of energy-dense snack foods. *Nutrients, 7*, 4093-4106. doi:10.3390/nu7064093

73. Khandpur, N., Blaine, R. E., Fisher, J. O., & Davison, K. K. (2014). Fathers' child feeding practices: A review of the evidence. *Appetite, 78*, 110-121. doi:10.1016/j.appet.2014.03.015

74. Larsen, J. K., Hermans, R. C., Sleddens, E. F., Engels, R. C., Fisher, J. O., & Kremers, S. P. (2015). How parental dietary behavior and food parenting practices affect children's dietary behavior. Interacting sources of influence? *Appetite, 89*, 246-257. doi:10.1016/j.appet.2015.02.012

75. Gevers, D. W. M., van Assema, P., Sleddens, E. F. C., de Vries, N. K., & Kremers, S. P. J. (2015). Associations between general parenting, restrictive snacking rules, and adolescent's snack intake. The roles of fathers and mothers and interparental congruence. *Appetite, 87*, 184-191. doi:10.1016/j.appet.2014.12.220

76. Sleddens, E. F. C., Gerards, S. M. P. L., Thijs, C., De Vries, N. K., & Kremers, S. P. J. (2011). General parenting, childhood overweight and obesity-inducing behaviors: A review. *International Journal of Pediatric Obesity, 6*, E12-E27. doi:10.3109/17477166.2011.566339

77. Larsen, J. K., Sleddens, E. F. C., Vink, J. M., Fisher, J. O., & Kremers, S. P. J. (2018). General parenting styles and children's obesity risk: Changing focus. *Frontiers in Psychology, 9*. doi:10.3389/fpsyg.2018.02119

78. Franco, A., Malhotra, N., & Simonovits, G. (2014). Publication bias in the social sciences: Unlocking the file drawer. *Science, 345*, 1502-1505. doi:10.1126/science.1255484

Appendix A

Full Search Strategy Including Limits per Database

Web of Science

TS = ("food parenting" OR "food parent* practice*" OR "home food environment" OR "parent* feed* practice*" OR "parent* feed* strateg*" OR "child feeding" OR "parent feeding" OR "feeding behavio*r" OR "feed* style*" OR "parent* feed* style*" OR "parenting" OR "parent* strateg*" OR "parent* communication" OR "parent child relations" OR "child rearing") AND TS = ("child*" OR "preschool*" OR "pre-school*" OR "pre-adolescen*" OR "early childhood" OR "schoolage*" OR "school-age*" OR "adolescen*" OR "p*ediatric*" OR "youth") AND TS = ("weight" OR "BMI" OR "body mass index" OR "obes*" OR "overweight" OR "weight status" OR "body weight" OR "adiposity" OR "anthropometric" OR "body composition" OR "body mass" OR "waist circumference" OR "fat" OR "fatness" OR "body size" OR "fat mass" OR "waist-hip ratio" OR "fat mass index") AND TS = ("follow up" OR "follow-up" OR "prospective" OR "longitudinal" OR "cohort" OR "long term")

Limits:

- *Language: English*
- *Timesmap=1990-2018*

PsycINFO

#1 ("food parenting" OR "food parent* practice*" OR "home food environment" OR "parent* feed* practice*" OR "parent* feed* strateg*" OR "child feeding" OR "parent feeding" OR "feeding behavio*r" OR "feed* style*" OR "parent* feed* style*" OR "parenting" OR "parent* strateg*" OR "parent* communication" OR "parent child relations" OR "child rearing").mp. AND ("child*" OR "preschool*" OR "pre-school*" OR "pre-

adolescen*" OR "early childhood" OR "schoolage*" OR "school-age*" OR "adolescen*" OR "p*ediatric*" OR "youth").mp. AND ("weight" OR "BMI" OR "body mass index" OR "obes*" OR "overweight" OR "weight status" OR "body weight" OR "adiposity" OR "anthropometric" OR "body composition" OR "body mass" OR "waist circumference" OR "fat" OR "fatness" OR "body size" OR "fat mass" OR "waist-hip ratio" OR "fat mass index").mp. AND ("follow up" OR "follow-up" OR "prospective" OR "longitudinal" OR "cohort" OR "long term").mp.

#2 Limit 1 to (English language and yr="1990-Current")

PubMed

(food parenting[tw] OR food parent* practice*[tw] OR home food environment[tw] OR parent* feed* practice*[tw] OR parent* feed* strateg*[tw] OR child feeding[tw] OR parent feeding[tw] OR feeding behavio*r[tw] OR feed* style*[tw] OR parent* feed* style*[tw] OR parenting[tw] OR parent* strateg*[tw] OR parent* communication[tw] OR parent child relations[tw] OR child rearing[tw]) AND (child*[tw] OR preschool*[tw] OR pre-school*[tw] OR pre-adolescen*[tw] OR early childhood[tw] OR schoolage*[tw] OR school-age*[tw] OR adolescen*[tw] OR p*ediatric*[tw] OR youth[tw]) AND (weight[tw] OR BMI[tw] OR body mass index[tw] OR obes*[tw] OR overweight[tw] OR weight status[tw] OR body weight[tw] OR adiposity[tw] OR anthropometric[tw] OR body composition[tw] OR body mass[tw] OR waist circumference[tw] OR fat[tw] OR fatness[tw] OR body size[tw] OR fat mass[tw] OR waist-hip ratio[tw] OR fat mass index[tw]) AND (follow up[tw] OR follow-up[tw] OR prospective[tw] OR longitudinal[tw] OR cohort[tw] OR long term[tw])

Limit to (English language and 01-01-1990 – 26-10-2018)

Appendix B

Information Included in the Data Extraction Table

Table S1

Information Included in the Data Extraction Table.

Domain	Information
Study characteristics	First author, year
	Comment
	Journal
	Country
Study aim	Research question and/or study objective
Cohort characteristics	Study name
	Study design
	Sample size
Research design	Number of relevant waves
	Time between waves
	Relevant measures per wave
Child characteristics	Age (first relevant measure of food parenting)
	Gender
	Weight status and/or zBMI at baseline
Parent Characteristics	Age
	Gender
	Education and/or Income and/or SES
	Weight status and/or BMI
	Race ethnicity
Measurement for food parenting	Which food parenting practices were assessed
	Instrument
	Reporter
	Covariates
	Mediators and/or moderators
Results	Findings
	Effect size

Appendix C

Scoring Guide for the Adapted National Heart, Lung and Blood institute's Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies

Criteria 1. Was the research question or objective in this paper clearly stated?

1 Research question or objective was stated within the introduction.

0 Research question and objective were both not stated within the introduction.

Criteria 2. Was the study population clearly specified and defined?

1 Following information was specified within the method section (or referred to an article specifying this information):

1. Who: Parents and/or children; Child age (baseline of follow-up); child gender
2. Where: Where were participants recruited?
3. When: Indication when the study took place (child year of birth, years of data collection).

0 At least one part of the above described information was not specified in the method section, nor was there a reference to an article specifying this information.

Criteria 3. Was the participation rate of eligible persons at least 50%?

1 Number of participants who gave informed consent/participated at baseline was at least 50% of all people who were invited to participate in the study.

0 Number of participants who gave informed consent/participated at baseline was lower than 50% of all people who were invited to participate in the study.

Criteria 4. Was the sample size justified?

1 Power analyses or effect size were was reported

0 No power analyses of effect size reported.

Criteria 5. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?

1 All exposure(s) were measured prior to the outcome(s).

0.5 Some, but not all, exposure(s) were measured prior to the outcome(s).

0 None of the exposure(s) were measured prior to the outcome(s), for example: the outcome was change zBMI from T1 to T3, with exposure being measured at T2.

Criteria 6. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if existed?

1 Follow-up assessment after measurement of exposure was at least 6 months.

0 Follow-up assessment after measurement of exposure was within 6 months.

Criteria 7. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome?

1 All exposures were continuous or categorical variables with at least 3 categories.

0.5 Some, but not all, exposures were continuous or categorical variables with at least 3 categories.

0 All exposures were categorical with 2 categories.

Criteria 8. Were the exposure measures clearly defined, valid, reliable and implemented consistently across all study participants?

1 For all measures, a reference towards a validation study was provided.

0.5 For some, but not all, measures a reference towards a validation study was provided.

0 For none of the measures a reference towards a validation study was provided.

Criteria 9. Was the exposure(s) assessed more than once over time?

1 All exposures were assessed more than once over time (thus at least 3 waves are needed).

0.5 Some, but not all, exposures were assessed more than once over time. Or exposures were assessed more than once, but due to child age only one assessment was relevant to this review.

0 None of the exposures were assessed more than once over time.

Criteria 10. Were the outcome measure(s) clearly defined, valid, reliable and implemented consistently across all study participants?

1 For the majority of the children (≥ 90%), all anthropometric measures were objective. If z-BMI or weight status were outcomes of interest, authors made use of WHO's or other (national) guidelines.

0 For more than 10% of the children at least some anthropometric measures were not objective. Or zBMI or weight status were not based on (national) guidelines.

Criteria 11. Was loss to follow-up after baseline 20% of less?

1 Loss to follow-up after baseline 20% or less.

0 Loss to follow-up more than 20%.

Criteria 12. Were key potential confounding variables measured, and adjusted statistically for in their impact on the relationship between exposure(s) and outcome(s)?

1 Adjusted for:

1. Baseline measure of outcome (not applicable if outcome is change in weight status; if outcome is change in (z)BMI, adjustments for baseline (z)BMI are required)
2. Measure of SES (e.g., SES, household income, education level)
3. Child age and gender (not applicable if homogeneous sample regarding age and gender).

0 Not adjusted for at least one of the above specified confounders.

Appendix D

Study Quality Assessment

Table S2

Study Quality Assessment (Alphabetically Ordered)

Criteria	References													
	Afonso et al. [19]	Agras et al. [20]	Anderson et al. [21]	Anzman and Birch [22]	Berge et al. [23]	Bergmeier et al. [24]	Bergmeier et al [25]	Campbell et al. [26]	Chang et al. [27]	Chang et al. [28]	Chong et al. [29]	Crossman et al. [30]	Derks et al. [31]	Faith et al. [32]
1. Research question clearly stated	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2. Study population clearly specified and defined	1	0	1	0	1	1	1	1	1	1	1	1	1	0
3. Participation rate of eligible persons at least 50%	1	0	1	CD	1	CD	CD	CD	CD	CD	1	CD	1	CD
4. Sample size justification	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5. Exposure assessed prior to outcome measurement*	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6. Sufficient timeframe to see an effect	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7. Different levels of the exposure of interest	1	1	1	1	1	1	1	1	1	1	1	0	1	1
8. Exposure measures clearly defined, valid, reliable*	1	0	0	1	0	0.5	1	1	0	0	0	0	1	1
9. Exposure assessed more than once over time	0	1	0	0	0	0	0	0	0	0	0	0	0	0
10. Outcome measures clearly defined, valid, reliable	1	CD	1	1	0	0	1	1	1	1	1	0	1	1
11. Loss to follow-up after baseline 20% or less	CD	0	CD	1	0	1	CD	0	CD	CD	0	0	0	CD
12. Adjusted for key potential confounding variables*	1	CD	0	0	1	0	0	0	1	1	0	1	1	0
Quality rating	Good	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Good	Fair

Table S2

Continued

Criteria	References												
	Faith et al. [33]	Francis and Birch [34]	Fulkerson et al. [35]	Fulkerson et al. [36]	Gable et al. [37]	Gregory et al. [38]	Gubbels et al. [39]	Hughes et al. [40]	Jansen et al. [41]	Lehto et al. [42]	Liszewska et al. [43]	Lumeng et al. [44]	Lumeng et al. [45]
1. Research question clearly stated	1	1	1	1	1	1	1	1	1	1	1	1	1
2. Study population clearly specified and defined	1	0	1	1	1	1	1	0	1	1	1	1	1
3. Participation rate of eligible persons at least 50%	CD	CD	1	CD	CD	CD	CD	CD	1	1	CD	CD	CD
4. Sample size justification	0	0	0	0	0	0	0	0	0	0	0	0	0
5. Exposure assessed prior to outcome measurement*	1	1	1	1	1	1	1	1	1	1	1	1	1
6. Sufficient timeframe to see an effect	1	1	1	1	1	1	1	1	1	1	1	1	1
7. Different levels of the exposure of interest	0.5	1	1	1	1	1	1	1	1	1	1	1	1
8. Exposure measures clearly defined, valid, reliable*	0	1	1	0	0	0.5	0.5	1	0.5	0	0.5	1	1
9. Exposure assessed more than once over time	0	1	0	0	1	0	0	0	0.5	0	0	0.5	0.5
10. Outcome measures clearly defined, valid, reliable	1	1	1	0	1	0	0	1	1	1	1	1	1
11. Loss to follow-up after baseline 20% or less	0	1	1	0	CD	1	1	1	CD	1	0	1	1
12. Adjusted for key potential confounding variables*	0	1	0	1	1	1	1	0	0	1	1	0	0
Quality rating	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair

Table S2

Continued

Criteria	References												
	Mason et al. [46]	McPhie et al. [47]	Quick et al. [48]	Rhee et al. [49]	Rodenburg et al. [50]	Rodgers et al. [51]	Rodgers et al. [52]	Sen [53]	Spruijt-Metz et al. [54]	Taveras et al. [55]	Tschann et al. [56]	Tung et al. [57]	Webber et al. [58]
1. Research question clearly stated	1	1	1	1	1	1	1	1	1	1	1	1	1
2. Study population clearly specified and defined	1	0	1	1	0	0	0	0	0	1	1	1	0
3. Participation rate of eligible persons at least 50%	CD	1	CD	1	1	CD	CD	CD	CD	1	0	1	CD
4. Sample size justification	0	0	0	0	0	0	0	0	0	0	0	0	0
5. Exposure assessed prior to outcome measurement*	1	1	1	1	1	1	1	0	1	1	1	1	1
6. Sufficient timeframe to see an effect	1	1	1	1	1	1	1	1	1	1	1	1	1
7. Different levels of the exposure of interest	1	1	1	1	1	1	1	1	1	1	1	1	1
8. Exposure measures clearly defined, valid, reliable*	0	1	0	0	0.5	0.5	1	0	1	0	1	1	1
9. Exposure assessed more than once over time	0	0	0	1	0	0	0	1	0	1	1	0	0
10. Outcome measures clearly defined, valid, reliable	0	0	0	1	1	0	0	0	1	0	1	1	1
11. Loss to follow-up after baseline 20% or less	0	0	0	CD	0	0	CD	CD	CD	1	CD	1	0
12. Adjusted for key potential confounding variables*	1	0	1	0	1	0	0	1	0	0	1	0	1
Quality rating	Fair	Fair	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Fair	Good	Good	Fair

Note. CD = Cannot determine; Good = 9 – 12 and at least 0.5 on all key criteria; Fair = 6 – 8.5, or 9 – 12 and 0 on at least one key criteria; Poor = 0 – 5.5.

* Key criteria