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# Parental autonomy-supportive food practices and fruit and vegetable consumption in children: A systematic review and meta-analysis

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ABSTRACT

This systematic review synthesizes evidence on the relationship between parental autonomy-supportive food practices and the consumption of fruit and vegetable in children aged 2–12 years. Six electronic databases (PubMed®, EMBASE®, Web of Science™, Scopus™, PsycINFO®, and LILACS®), Google Scholar®, and reference lists were systematically searched for studies published before January 9, 2025. Studies assessing autonomy-supportive food practices (reported by caregivers and/or children) and child consumption of fruit and/or vegetable were included. Data were collected using a standardized form, risk of bias was evaluated using the Joanna Briggs Institute tools. Two authors independently conducted all review steps, and a third reviewer resolved disagreements. A random-effects model was applied, and stratified meta-analyses were performed using R software. A total of 53 studies were included. Although individual study results were inconsistent, a correlation-based meta-analysis found weak but significant associations of verbal and visual encouragement to eat (K = 36; r = 0.17, 95 % confidence interval [CI] [0.13, 0.21]) and involvement (K = 13; r = 0.13, 95 % CI [0.09, 0.16]) with children's fruit and vegetable consumption; significance persisted in the regression-based meta-analysis (encouragement to eat: K = 14; β = 0.07, 95 % CI [0.02, 0.12]; involvement: K = 5; β = 0.10, 95 % CI [0.04, 0.16]). Teachable moments, praise, and negotiation showed weak but significant correlations (r ranging from 0.11 to 0.16). Findings suggest that verbal and visual encouragement to eat and involvement are associated with children's fruit and vegetable intake. Teachable moments, praise, and negotiation show weak positive correlations, although all these associations have small effect sizes and are primarily derived from cross-sectional studies in high-income countries.

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## 1. Introduction

Achieving well-being and maintaining a healthy life, as highlighted in the 3rd Sustainable Development Goal, is necessary to ensure sustainable development for present and future generations (United Nations, 2015). In this context, adequate consumption of fruit and vegetables is indispensable (Devirgiliis et al., 2024). However, in many parts of the world, a large number of children do not achieve recommended fruit and vegetables daily consumption (Carneiro et al., 2024; Hamner et al., 2023; UNICEF/FIC Argentina, 2023; Williams et al., 2020). Therefore, it is essential to support and promote the development

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**Abbreviations**

| | |
|---|---|
| ASD | Autism Spectrum Disorder |
| 95 %CI | 95 % Confidence Intervals |
| CFPQ | Comprehensive Feeding Practices Questionnaire |
| EMBASE | Excerpta Medica Database |
| EMA | Ecological Momentary Assessment |
| FFQ | Food Frequency Questionnaire |
| IRR | Inter-rater reliability |
| LILACS | Latin American and Caribbean Health Sciences Literature |
| OR | Odds ratio |
| PICO | Population, Intervention/Exposure, Comparison, Outcomes, and Study Design |
| PRISMA | Preferred Reporting Items for Systematic Reviews and Meta-Analyses |
| PROSPERO | International Prospective Register of Systematic Reviews |
| PUBMED | National Library of Medicine |
| PFPQ | Parental Feeding Practice Questionnaire |
| 24-h recall | 24-h recall |
| SDT | Self-Determination Theory |

of healthy eating habits and self-regulation from an early age, as dietary patterns and preferences established in childhood seem to remain stable through adolescence (Northstone & Emmett, 2008) and adulthood (Mikkilä et al., 2005).

Eating habits and preferences are complex, since these are shaped by various interrelated factors, including individual differences and genetic predispositions (Hejazi et al., 2024), as well as family, community, and social influences (Scaglioni et al., 2018; Stok et al., 2017). Among these, the home and family environment — particularly food parenting practices — play an essential role in shaping children's eating habits (Fig. 1), with significant impacts on their health and development (Vaughn et al., 2016). Parents and other primary caregivers (e.g., grandparents) play an important role in structuring this environment and act as key agents in the socialization process of their children, guiding them toward what to value and pursue in life (Hughes & Power, 2018; Jongenelis et al., 2020).

Food parenting practices encompass a range of interactive behaviors between parents and children, whether intentional or not, that have a significant influence on shaping children's attitudes, behaviors, and beliefs about food (Vaughn et al., 2016). These practices can vary widely, with some being more intrusive and demanding, such as pressuring the child to eat, restricting access to certain foods to control body weight, or using food as a reward for good behavior. On the other hand, other practices are characterized as being more supportive and nurturing, such as involving the child in food preparation, encouraging healthy eating habits, and praising their efforts when trying new foods (Vaughn et al., 2016). Vaughn et al. (2016) categorized these practices into three broad constructs: "Coercive Control," "Structure," and "Autonomy Support", which are believed to influence children's motivation to eat (Di Pasquale & Rivolta, 2018).

Some previous systematic reviews have examined the relationship between food parenting practices and child and adolescent fruit and vegetable consumption (Ong et al., 2017; Yee et al., 2017). However, these studies were published nearly a decade ago and primarily focused on coercive control and structure practices. Furthermore, there has been limited research on parental autonomy-supportive practices (Vaughn et al., 2016). Consequently, there is still no clear understanding of which parental autonomy-supportive practices are most related to children's consumption of fruit and vegetables. Given the growing interest in this topic and recent refinements in assessment tools (Power et al., 2019; Savage et al., 2017; Taylor et al., 2017; Vaughn et al., 2017), an updated systematic review is necessary to evaluate the strategies parents use to effectively support and encourage their children's fruit and vegetable consumption.

This systematic review and meta-analysis aims to synthesize the available evidence on the relationship between parental autonomy-supportive food practices, as proposed by Vaughn et al. (2016), and the consumption of fruit and/or vegetables among children aged 2–12 years. The results of this review will provide evidence to guide parents and professionals in promoting healthy eating habits during childhood and are expected to identify gaps for future research.

## 2. Materials and methods

### 2.1. Protocol and registration

This systematic review aimed to answer the following research question: "*Is there a relationship between parental autonomy-supportive food practices, as proposed by* Vaughn et al. (2016)*, and fruit and/or vegetable consumption in children aged 2 to 12 years?*". The PICOS framework (Population, Intervention/Exposure, Comparison, Outcomes, and Study design) was used to formulate the research question. The review was reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). A completed PRISMA checklist is available in Supplementary Table S1. The review protocol was previously submitted and registered in the International Prospective Register of Systematic Reviews (PROSPERO) under the number CRD42023442680 to ensure transparency and reproducibility and to avoid duplication of efforts on the same research topic. The protocol has also been published elsewhere (Lopes et al., 2025). Since this study involved existing literature, ethical approval was not required.

### 2.2. Information sources and search strategy

The databases searched included PubMed® (U.S. National Library of Medicine), Scopus™ (Elsevier), Web of Science™, PsycINFO® (American Psychological Association), EMBASE® (Elsevier), and LILACS® (BIREME/PAHO/WHO). In addition, other published studies not available in these databases were searched via Google Scholar® (limited to the first 100 records). Finally, a manual search was conducted on the reference lists of the articles included in this review to identify any additional relevant studies. No restrictions were applied regarding publication year or language. Two reviewers independently completed the entire search process (E.C.L. and P.R.V.), and a third reviewer (P.R.M.) was consulted to resolve any disagreements.

An initial search, limited to the PubMed® database, was conducted prior to defining the search strategy to determine whether any potential studies met the eligibility criteria for this review. This preliminary search served as the basis for developing the search strategy. Additionally, following the recommendation of Greenhalgh and Peacock (2005), experts in systematic reviews who were part of the team (G.M.A. and S.W.) were consulted to refine the literature search strategy. Literature searches were conducted on January 2, 2024, and updated on January 9, 2025. The search terms for this systematic review included keywords related to the population (e.g., "child," "preschoolers"), intervention (e.g., "parenting", "parental feeding practices"), and outcomes (e.g., "food intake," "healthy eating"). Detailed search strategies for each database can be found in Supplementary Table S2.

### 2.3. Study eligibility criteria

Studies were eligible for inclusion if they assessed at least one parental autonomy-supportive food practice reported by caregivers and/or by healthy children aged 2–12 years themselves, and measured their consumption or preference for fruit and/or vegetable as an outcome.

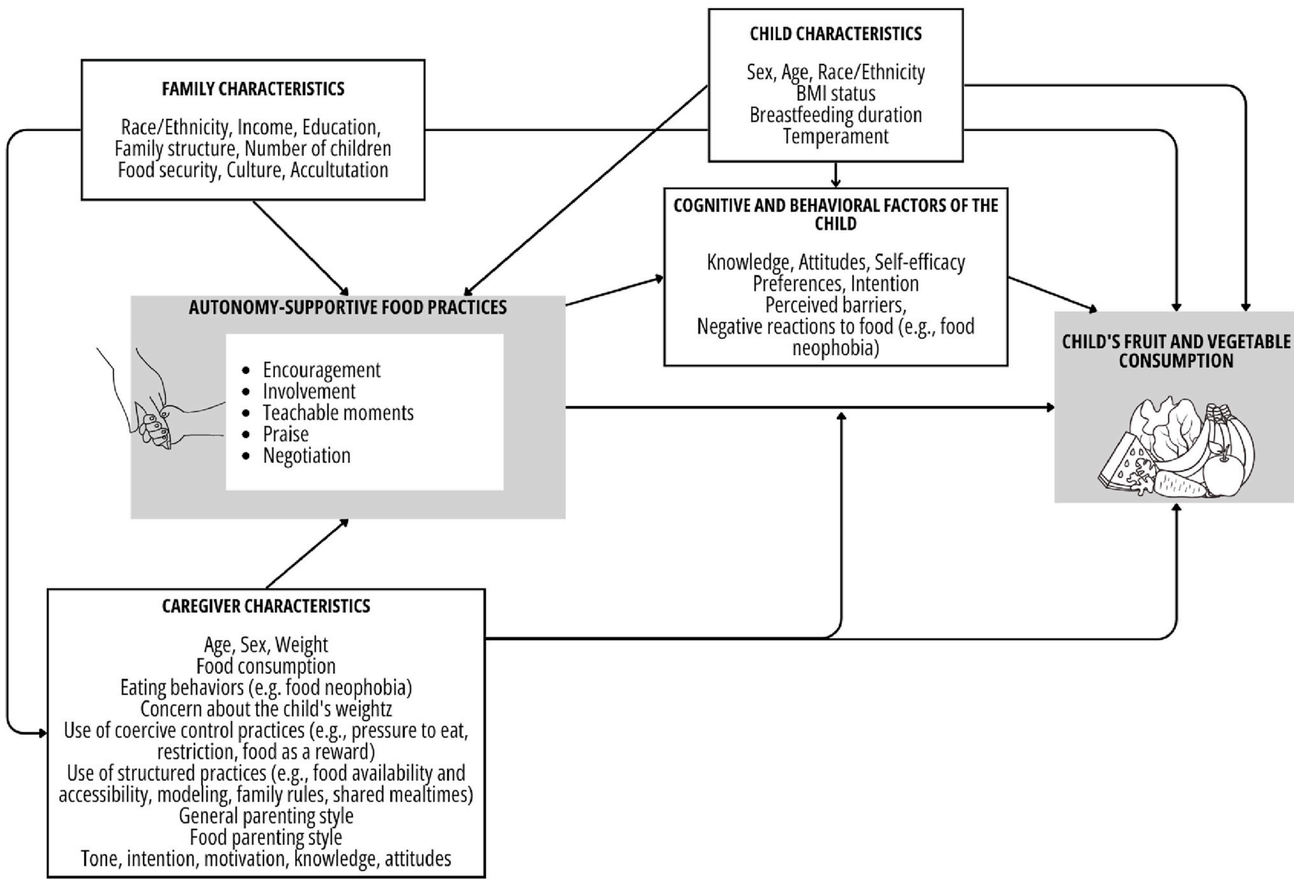


**Fig. 1.** Conceptual Model of the Association between Autonomy-Supportive Food Parenting Practices and Children's Consumption of Fruit and Vegetable, accounting for confounders, mediators, and moderators.
**Note:** This is an adaptation of the Conceptual Model of Food Parenting Practices from Vaughn et al. (2016), which focuses on the association between autonomy-supportive food parenting practices and children's consumption of fruit and vegetables (FV) as the primary outcome. Key modifications include adding caregiver variables (e.g., age, sex, dietary intake, eating behaviors) and distinguishing child characteristics (demographic and anthropometric) from child cognitive and behavioral factors (e.g., self-efficacy, temperament) to clarify relevant confounders and to highlight potential mediating and moderating roles between parenting practices and FV intake.
**Source:** Adapted from Vaughn et al. (2016).

The eligibility criteria, detailed by population, exposure/intervention, outcome, and study design, are presented in Table 1.

This review focuses on children aged 2–12 years, as this is a critical period in which parents exert significant influence over the development of eating habits, shaping their children's attitudes and perceptions regarding food (Balantekin et al., 2020; Vaughn et al., 2016). While parental influence diminishes as children grow, it remains more pronounced in this age group compared to adolescence (Balantekin et al., 2020). The choice for this age range is initially based on Piaget's theory, which divides intellectual development into stages, including the pre-operational (2–7 years) and concrete operational (7–11 years) periods (Ginsburg & Opper, 1988). However, we have extended the upper limit to 12 years, as many studies examining food parenting practices encompass a broader age range, often including children slightly older than 11 years.

Although the protocol for this review specified the inclusion of caregiver reports, studies based solely on child reports were also included, as incorporating both perspectives enriches the understanding of food parenting practices. Naturally, studies that assessed only children as respondents focused on older participants (ages 8–12 years), an age range considered cognitively capable of providing valid and reliable accounts of their experiences (Riley, 2004). Furthermore, both observational and interventional studies were included to provide a more comprehensive synthesis of the scientific literature, with interventional studies complementing observational ones by offering stronger causal evidence (Rosenman, 2025). In this review, the term "caregivers" refers to parents and/or guardians, as the included studies consider both parents and other adults responsible for children's feeding.

### *2.4. Study selection process*

After completing the searches, the metadata were imported into Zotero 6.0 (Corporation for Digital Scholarship, Fairfax, VA) in RIS format. Duplicates were automatically identified and removed by the software. The results were then transferred to Rayyan®, a software specifically designed for systematic reviews, where the remaining duplicates were manually removed (Ouzzani et al., 2016). Two independent reviewers (E.C.L. and P.R.V.) conducted a two-phase screening process. In the first phase, the reviewers read the titles and abstracts in Rayyan® to assess compliance with the eligibility criteria. During the second phase, the same two reviewers read the full-text articles identified in the first phase to confirm eligibility. Discrepancies between the two independent reviewers in both phases were resolved by a third reviewer (P.R.M.). Finally, the eligible articles were included in this systematic review. The process of identifying and selecting studies for this systematic review was documented and illustrated in Fig. 2. Inter-rater reliability (IRR) was assessed by calculating the percentage of agreement and Cohen's Kappa coefficient (McHugh, 2012). Agreement between reviewers was high in both screening phases (title and abstract screening: IRR = 94.28 %, Kappa = 0.868; full-text screening: IRR =

**Table 1**
Inclusion and exclusion criteria, following the PICOS parameter.

| PICOS Parameter | Inclusion criteria | Exclusion criteria |
|---|---|---|
| *Population* | Caregivers of healthy children, or children themselves, aged 2–12 years. | Caregivers of children, or children themselves, with any condition that may influence eating (e.g., celiac disease, food allergies, food intolerances, Autism Spectrum Disorder (ASD), Down syndrome, diabetes) were excluded. |
| *Exposure/ Intervention* | Assessed at least one parental autonomy-supportive food practice as described by Vaughn et al. (2016).<br>Assessed food parenting practices using validated instruments or tools, including evaluation of internal consistency of items. | Studies that used statistical approaches to combine food parenting practices from multiple domains into a single variable, i.e., assessing patterns/profiles of food parenting practices. However, patterns or profiles that encompass only autonomy-supportive food practices were included in this review. |
| *Comparison* | Not applicable | |
| *Outcomes* | Assessed fruit and/or vegetable consumption through a food frequency questionnaire, 24-h dietary recall, food diaries, and/or direct weighing of foods, or evaluated food preferences.<br>Assessed combined consumption of fruit and vegetable within a single variable category or assessed fruit and vegetable as separate measures. | Studies that combined fruit and vegetable consumption with other foods (e.g., whole grains, dairy). |
| *Study design* | Observational studies (cross-sectional, cohort, case–control).<br>Intervention studies (randomized controlled trials and experimental studies). | Studies with missing and/or unclear data, even after requesting information from the authors, letters, reviews, conference abstracts, opinion articles, case reports, poster presentations, news summaries, theses, and dissertations. |

95.63 %, Kappa = 0.803).

## 2.5. Data extraction

Data extraction was independently performed by two reviewers (E.C. L. and P.R.V.) using Rayyan® software, and the extracted data were subsequently compared for consistency. When necessary, discrepancies were resolved by a third reviewer (P.R.M.). An extraction spreadsheet was created to capture the following information: publication details (authors, year, country), study type, participant characteristics (age, sex, sample size), autonomy practices assessed, instruments used to evaluate these practices, method of food consumption assessment, confounding variables, primary results, and limitations. For information not presented in the studies, the authors of the included studies were contacted twice via email, with a 15-day interval if there was no response to the first email.

## 2.6. Methodological quality of the studies

The risk of bias of eligible articles was assessed using the tools developed by the Joanna Briggs Institute (Barker et al., 2024; Moola et al., 2020) by two independent reviewers (E.C.L. and P.R.V.), based on the study design. Each article was evaluated using the corresponding checklist, and the responses were categorized as follows: "Yes" if the requirement was met, "No" if it was not met, "Unclear" if the information was ambiguous, and "NA" if not applicable. Disagreements between the independent reviewers were resolved by a third reviewer (P.R.M.). Studies were classified by risk of bias into three categories based on the proportion of "Yes" responses: high risk (<70 %), moderate risk (70–89 %), and low risk (≥90 %), following an approach adapted from Mendes et al. (2023). The risk of bias assessment was not used as an eligibility criterion for study inclusion to avoid selection bias and preserve the comprehensiveness of the body of evidence, in accordance with methodological guidelines for systematic reviews (USDA Nutrition Evidence Systematic Review Branch, 2023).

## 2.7. Data analysis

All analyses were performed using R software, version 4.4.3 (R Core Team, 2025). The meta-analysis utilized the *metafor, meta*, and *dmetar* packages to estimate the effect size (Balduzzi et al., 2019). Only studies that provided the necessary quantitative information to calculate the overall effect size were included, such as Pearson's correlation coefficients (r), odds ratios (OR), and regression coefficients (β). Studies that used Spearman's correlation coefficients were also included, as these values are comparable to or slightly lower than Pearson's product-moment correlation coefficients (Gilpin, 1993).

Since the measure of fruit and vegetable consumption varied across studies (i.e., the units of the outcome variable differed between studies), standardized regression coefficients were used. When standardized betas and their 95 % confidence intervals (95 %CI) were not directly provided, they were calculated using the following formula:

$$\text{unstandardized beta} \times \left(\widehat{\sigma}_{exposure} \ / \ \widehat{\sigma}_{outcome}\right) \quad (1)$$

For parenting practices such as negotiation and praise, OR were used, as the majority of studies reported OR for these practices.

Correlation and regression coefficients were weighted by sample size and standard error and pooled using a random-effects model to account for between-study variability. Heterogeneity was assessed using the $I^2$ statistic (%) and Cochran's Q test. $I^2$ thresholds of 25 %, 50 %, and 75 % indicated low, moderate, and high heterogeneity, respectively (Higgins et al., 2003). Statistical significance for all pooled effects was established with a p-value <0.05, which corresponds to a 95 %CI that did not include the null hypothesis value (0 for correlation and regression coefficients; 1 for Odds Ratios). Effect sizes were classified according to Cohen's criteria: small ($0.10 \leq r < 0.30$), moderate ($0.30 \leq r < 0.50$), and large ($r \geq 0.50$) (Cohen, 2013).

Analyses included coefficients from studies that measured fruit and vegetable consumption combined, as well as those assessing them separately. In cases of high heterogeneity, subgroup analyses tested whether outcome type (fruit, vegetable, or both) influenced heterogeneity; no such effect was found, so results were presented without separating fruit and vegetable.

For the practice of verbal and visual encouragement to eat, which showed moderate heterogeneity in regression models and high heterogeneity in correlation models, analyses were stratified by the following factors: country of study, children's age group (2–6 and 7–12 years), method or instrument used to assess food parenting practices, type of outcome (food preference or consumption), nature of the outcome (separate or combined fruit and vegetable consumption or preference), dietary assessment method (Food Frequency Questionnaire [FFQ], 24-h recall, direct weighing, Ecological Momentary Assessment [EMA]), and report perspective (parent or child report). Age groups followed Piaget's developmental stages, with the upper limit extended to 12 years to match included studies.

Although subgroup analyses by study design (such as longitudinal and cross-sectional) were planned, only cross-sectional studies and two longitudinal studies (Radtke et al., 2019; Rodenburg et al., 2014) were eligible, preventing stratified analysis. Moreover, stratified analyses by caregivers and child sex was not possible due to an insufficient number of studies reporting sex-disaggregated results; only two presented data separated by sex. One study conducted separate analyses by caregiver

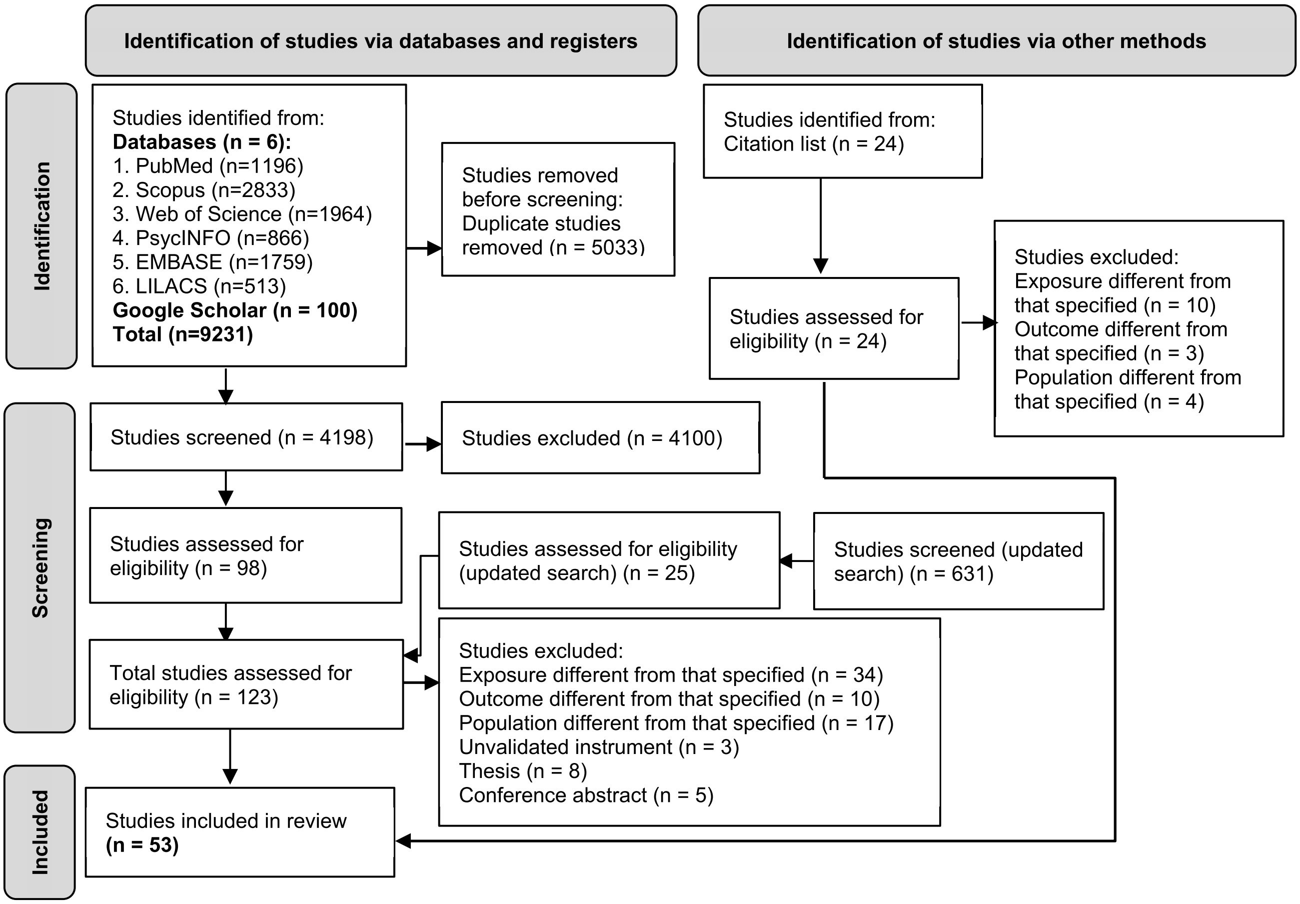


**Fig. 2.** PRISMA flow diagram of the literature search and study selection process for the systematic review (Page et al., 2021).

sex (Lopez et al., 2022), and the other one was conducted exclusively with fathers (Lo et al., 2025), while the remaining studies had predominantly maternal samples without analytical distinction between caregivers. Studies that assessed food consumption in ways not comparable to others (e.g., in a school setting or through a single laboratory assessment) were excluded from the meta-analysis but were maintained in the overall literature review.

Egger's test of asymmetry and a funnel plot were used to assess publication bias. Additionally, sensitivity analysis was performed to evaluate the robustness of the results, employing influence analysis to assess the impact of each study on the overall findings, as well as outlier detection to identify extreme values that could affect the meta-analysis.

## 3. Results

Fig. 2 illustrates the PRISMA flow diagram for the study selection process. The initial database search identified 9231 records. After removing duplicates, 4198 records remained for the title and abstract screening, leading to the selection of 98 articles for full-text review. To ensure the inclusion of recent studies, an updated search was conducted, identifying 25 additional articles for full-text review. Of the 123 manuscripts analyzed, 77 were excluded for not meeting eligibility criteria. As a result, 46 articles met the eligibility criteria. Furthermore, seven manuscripts (De Bourdeaudhuij et al., 2005; Kalantari & Doaei, 2014; Kristjansdottir et al., 2006, 2009; Sandvik et al., 2007; Tak et al., 2008; Wind et al., 2006) were included after conducting a manual search of the reference list of the selected studies, resulting in a total of 53 manuscripts.

### 3.1. *Characterization of included studies*

The studies included in this review were published between 2004 and 2025 and spanned four continents: North America, Europe, Asia, and Oceania. The majority of the studies were conducted in the United States (n = 18; 34.0 %), followed by Belgium (n = 7; 13.2 %), the Netherlands (n = 6; 11.3 %), and Norway (n = 5; 9.4 %). Notably, three studies involved multiple countries, all of which were conducted in Europe (De Bourdeaudhuij et al., 2005; Sandvik et al., 2007; Wind et al., 2006). According to the World Bank's income classification for countries (World Bank Country and Lending Groups – World Bank Data Help Desk, n.d.), 49 studies were conducted in high-income countries, while the remaining were conducted in upper-middle-income countries.

Most studies had a cross-sectional study design (n = 44; 83.02 %), with sample sizes ranging from 22 to 5926 participants. Nearly half included fewer than 500 participants, while about a quarter involved more than 1000 individuals. The studies primarily focused on children aged between 2 and 6 years (n = 22; 41.5 %) and those aged between 7 and 12 years (n = 24; 45.3 %), while fewer covered both age groups (n = 7; 13.2 %). Almost half of the studies included direct participation from both caregivers and children, while the remaining studies assessed only caregivers (n = 22; 41.5 %) or only children (n = 6; 11.3 %). Notably, 39 studies predominantly sampled mothers, with proportions ranging from 68.1 % to 95 %, or exclusively included mothers. The general characteristics and principal findings are summarized in Supplementary Tables S3 and S5.

### 3.2. *Assessment of food parenting practices*

In most studies, food parenting practices were assessed through caregiver reports (n = 42; 79.2 %), primarily using psychometric instruments (n = 48; 90.6 %). Although the instruments showed considerable variability, the most commonly used were the Comprehensive Feeding Practices Questionnaire (CFPQ) (Musher-Eizenman & Holub, 2007), and its adaptation (n = 12; 22.6 %), the Parental Feeding Practice Questionnaire (PFPQ) (Wardle et al., 2002) (n = 8; 15.1 %), and the questionnaire developed for the Pro Children Project (n = 8; 15.1 %). Beyond psychometric instruments, three studies investigated food parenting practices in participants' natural environments (e.g., participants' home) (Do et al., 2020; Lopez et al., 2022; Rodríguez-Arauz & Ramírez-Esparza, 2022).

Two of these studies used the EMA (Do et al., 2020; Lopez et al., 2022) via smartphones to collect real-time data from families. In contrast, a third study employed an audio recording device to capture caregiver-child interactions during daily activities (Rodríguez-Arauz & Ramírez-Esparza, 2022). Another study assessed food parenting practices in a laboratory setting using a structured protocol (Jordan et al., 2020) to evaluate maternal verbal strategies for encouraging child food consumption. Finally, one experimental study examined the effect of children's involvement in meal preparation on subsequent food intake (van der Horst et al., 2014). Assessment methods for food parenting practices in each study is provided in Supplementary Table S5.

### 3.3. Assessment of food consumption and food preferences

The methods used to evaluate children's food consumption and preferences varied significantly across studies. The most commonly used tool was the FFQ, which assessed the frequency or quantity of food consumed (n = 38; 71.7 %). Other studies employed food markers, 24-h recall, direct food weighing, food preference questionnaires, or EMA. Regarding fruit and vegetable consumption, studies assessed this food group separately (n = 36; 67.9 %), combined (n = 16; 30.2 %), or pooled (n = 1; 1.9 %). The moments considered for evaluating child food consumption also varied among studies. The most frequent moment was habitual consumption (n = 16; 42.1 %), followed by intake over the past seven days (n = 8; 21.1 %) and the past month (n = 6; 15.8 %). A breakdown of the methods used for assessing food consumption in each study is provided in Supplementary Table S5.

### 3.4. Methodological quality of the studies

Thirty studies (56.6 %) had a low risk of bias (Chen et al., 2021; Conlon et al., 2019; Couch et al., 2014; Do et al., 2020; Ha et al., 2022; Haβ & Hartmann, 2018; Heredia et al., 2016; Jordan et al., 2020; Kalantari & Doaei, 2014; Kaukonen et al., 2019; Kristjansdottir et al., 2006; Lo et al., 2025; Lopez et al., 2022; Metcalfe & Fiese, 2018; Papaioannou et al., 2013; Qiu et al., 2023; Quah et al., 2018; Radtke et al., 2019; Rodenburg et al., 2014; Sandvik et al., 2007; Shim et al., 2016; Sleddens et al., 2014; Tak et al., 2008; Taylor et al., 2017; van der Horst et al., 2014; Vereecken, Rovner, & Maes, 2010; Vollmer & Baietto, 2017; Warkentin et al., 2020; Wind et al., 2006; Zeinstra et al., 2010), nineteen (35.8 %) were classified as having a moderate risk of bias (Afonso et al., 2020; Al-Buobayd et al., 2023; Entin et al., 2014; Gray et al., 2023; Haszard et al., 2015; Hendy et al., 2009; Inhulsen et al., 2017; Kaar et al., 2016; Kristjansdottir et al., 2009; Kröller & Warschburger, 2008; Lo et al., 2015; McGowan et al., 2012; Melbye et al., 2012, 2013; Rodríguez-Arauz & Ramírez-Esparza, 2022; Vaughn et al., 2017; Vereecken et al., 2004, 2009, 2010b), and four (7.6 %) had a high risk of bias (De Bourdeaudhuij et al., 2005; Melbye & Hansen, 2015; Vereecken et al., 2005; Wolnicka et al., 2015). The most frequently identified sources of bias included unclear inclusion criteria, failure to adjust for confounding factors, use of inappropriate methods for measuring the outcome validly and reliably, and insufficient description of participants and study setting. Agreement between reviewers was considered high (IRR = 89.1 %, Kappa = 0.81) (McHugh, 2012). The risk of bias assessment for each included study is presented in Supplementary Tables S3, S6, and S7.

### 3.5. Main findings

To ensure consistency in categorizing food parenting practices, this review maintained the terminology used across studies when uniform. However, some studies employed distinct terms to describe similar practices as also described previously (Vaughn et al., 2016). When different labels referred to constructs that predominantly assessed the same concept, we adopted terminology that more accurately reflected the underlying food parenting practice. For example, the construct Emotional Support for Healthy Eating — assessed by items such as (1) "I show approval when my child eats what I want them to eat" and (2) "I encourage my child to try new foods" in Heredia et al. (2016) — was classified as "Verbal and Visual Encouragement to Eat."

#### 3.5.1. Verbal and visual encouragement to eat

Verbal and visual encouragement to eat is described as the use of positive, gentle, and supportive strategies to inspire children to adopt healthy eating habits or to encourage them to consume specific foods without pressuring them (O'Connor et al., 2017; Vaughn et al., 2016). Despite this conceptual definition, the operationalization of encouragement in research instruments is broad and multifaceted. The measurement of encouragement often encompasses a set of interconnected strategies, such as verbally encouraging the child to try new foods, offering praise, presenting foods attractively, and using reasoning. Vaughn et al. (2016) themselves acknowledge that strategies such as praise, reasoning, and negotiation can serve as specific forms of encouragement and support.

Of the studies included, 38 examined the relationship between parental verbal and visual encouragement to eat, and either children's fruit and vegetable consumption or their preference for these foods. Of these, 36 assessed the association between encouragement and the consumption of fruit (Al-Buobayd et al., 2023; De Bourdeaudhuij et al., 2005; Entin et al., 2014; Gray et al., 2023; Inhulsen et al., 2017; Kristjansdottir et al., 2006, 2009; Lo et al., 2015, 2025; McGowan et al., 2012; Melbye et al., 2012; Quah et al., 2018; Rodenburg et al., 2014; Sandvik et al., 2007; Shim et al., 2016; Sleddens et al., 2014; Tak et al., 2008; Vereecken, Rovner, & Maes, 2010; Wind et al., 2006; Wolnicka et al., 2015), vegetable (Al-Buobayd et al., 2023; De Bourdeaudhuij et al., 2005; Entin et al., 2014; Gray et al., 2023; Inhulsen et al., 2017; Jordan et al., 2020; Kaukonen et al., 2019; Kristjansdottir et al., 2006, 2009; Lo et al., 2015, 2025; McGowan et al., 2012; Melbye et al., 2012, 2013; Melbye & Hansen, 2015; Quah et al., 2018; Shim et al., 2016; Tak et al., 2008; Vereecken, Rovner, & Maes, 2010; Wind et al., 2006), or pooled food groups combined (Afonso et al., 2020; Couch et al., 2014; Do et al., 2020; Gray et al., 2023; Ha et al., 2022; Haszard et al., 2015; Haβ & Hartmann, 2018; Heredia et al., 2016; Kalantari & Doaei, 2014; Taylor et al., 2017; Vaughn et al., 2017; Warkentin et al., 2020). Additionally, two studies (Qiu et al., 2023; Vollmer & Baietto, 2017) investigated the relationship between this practice and children's food preferences, without assessing consumption.

Only five studies were longitudinal (Do et al., 2020; Lopez et al., 2022; Rodenburg et al., 2014; Sleddens et al., 2014; Tak et al., 2008), while the others had a cross-sectional design. The assessment of practices was primarily based on retrospective reporting. Of the included studies, 28 relied on parental reports (Afonso et al., 2020; Al-Buobayd et al., 2023; Couch et al., 2014; Entin et al., 2014; Gray et al., 2023; Ha et al., 2022; Haszard et al., 2015; Haβ & Hartmann, 2018; Heredia et al., 2016; Inhulsen et al., 2017; Kalantari & Doaei, 2014; Kaukonen et al., 2019; Lo et al., 2015, 2025; McGowan et al., 2012; Melbye et al., 2012, 2013; Melbye & Hansen, 2015; Qiu et al., 2023; Quah et al., 2018; Rodenburg et al., 2014; Shim et al., 2016; Sleddens et al., 2014; Taylor et al., 2017; Vaughn et al., 2017; Vereecken, Rovner, & Maes, 2010; Vollmer & Baietto, 2017; Warkentin et al., 2020), six on children's reports (De Bourdeaudhuij et al., 2005; Kristjansdottir et al., 2006;

Sandvik et al., 2007; Tak et al., 2008; Wind et al., 2006; Wolnicka et al., 2015), and one study considered both (Kristjansdottir et al., 2009). Additionally, two studies employed EMA (Do et al., 2020; Lopez et al., 2022) and another used direct observation in a laboratory feeding protocol (Jordan et al., 2020).

Among the 33 cross-sectional studies, 18 (54.5 %) found a positive relationship between verbal and visual encouragement to eat and child consumption of fruit (Al-Buobayd et al., 2023; De Bourdeaudhuij et al., 2005; Inhulsen et al., 2017; Lo et al., 2015, 2025; Sandvik et al., 2007; Shim et al., 2016; Vereecken, Rovner, & Maes, 2010; Wolnicka et al., 2015), vegetables (Al-Buobayd et al., 2023; De Bourdeaudhuij et al., 2005; Entin et al., 2014; Gray et al., 2023; Inhulsen et al., 2017; Lo et al., 2015; McGowan et al., 2012; Melbye et al., 2013; Melbye & Hansen, 2015; Quah et al., 2018; Vereecken, Rovner, & Maes, 2010; Wolnicka et al., 2015), or FV combined (Couch et al., 2014; Gray et al., 2023; Haszard et al., 2015; Vaughn et al., 2017). Notably, six studies (De Bourdeaudhuij et al., 2005; Entin et al., 2014; Melbye & Hansen, 2015; Sandvik et al., 2007; Vaughn et al., 2017; Wolnicka et al., 2015) focused solely on bivariate analyses without considering other confounding factors. Conversely, three studies (9.1 %) (Kristjansdottir et al., 2006, 2009; Warkentin et al., 2020) reported a negative relationship, while 12 studies (36.4 %) (Afonso et al., 2020; Ha et al., 2022; Haβ & Hartmann, 2018; Heredia et al., 2016; Jordan et al., 2020; Kalantari & Doaei, 2014; Kaukonen et al., 2019; Melbye et al., 2013; Qiu et al., 2023; Taylor et al., 2017; Vollmer & Baietto, 2017; Wind et al., 2006) found no statistically significant associations. Although the authors of one study (Kristjansdottir et al., 2009) found a negative association between encouragement to eat and child fruit and vegetable consumption, the question used for evaluation ("Do you persuade your child to eat fruits?") may reflect a coercive practice rather than guidance based on supporting autonomy.

Across five longitudinal studies, four reported at least one statistically significant association between verbal and visual encouragement to eat and children's FV intake. In Tak et al. (2008; Dutch Schoolgruiten and Pro Children), it was associated with increased or maintained vegetable intake at the first time point, but not at the second. In Sleddens et al. (2014), a positive association with fruit intake persisted after adjusting for sociodemographics and other food parenting practices (e.g., instrumental/emotional feeding and overt/covert control), but lost significance after adjusting for baseline child fruit intake.

Across two EMA studies (Do et al., 2020; Lopez et al., 2022), no between-subjects associations were detected; however, within-subject analyses revealed that higher-than-usual maternal encouragement increased children's FV intake. In Los Angeles (US), maternal encouragement to eat roughly doubled the odds of consumption (N = 191; OR [95 %CI] = 2.41 [1.92, 3.03]) during the same period (Do et al., 2020), while in California (US), only maternal, not paternal, encouragement was associated with child fruit intake (Lopez et al., 2022).

### 3.5.2. Involvement

Involvement refers to the child's active engagement in food purchasing, meal planning, preparation, and during mealtime to encourage healthier eating habits. Parents can foster a sense of independence by acknowledging their child's preferences and desires. They also use these moments to promote family and cultural norms and introduce the child to new foods (O'Connor et al., 2017; Vaughn et al., 2016).

Thirteen studies examined the relationship between children's involvement in food-related activities and either their fruit and vegetable consumption or their preference for these foods. Of these, 12 assessed the association between involvement and child consumption of fruit (Chen et al., 2021; Entin et al., 2014; Melbye et al., 2012; Metcalfe & Fiese, 2018; Quah et al., 2018; Shim et al., 2016), vegetable (Chen et al., 2021; Entin et al., 2014; Kaukonen et al., 2019; Melbye et al., 2012, 2013; Metcalfe & Fiese, 2018; Quah et al., 2018; Radtke et al., 2019; Shim et al., 2016; van der Horst et al., 2014), or pooled food groups combined (Kalantari & Doaei, 2014; Taylor et al., 2017). Additionally, two studies (Radtke et al., 2019; Vollmer & Baietto, 2017) investigated the relationship between involvement and children's food preferences.

Ten studies had a cross-sectional design (Chen et al., 2021; Entin et al., 2014; Kalantari & Doaei, 2014; Kaukonen et al., 2019; Melbye et al., 2012, 2013; Quah et al., 2018; Shim et al., 2016; Taylor et al., 2017; Vollmer & Baietto, 2017), two were longitudinal (Metcalfe & Fiese, 2018; Radtke et al., 2019), and one was an experimental study (van der Horst et al., 2014). Except for the experimental study, all studies relied on parental reports. Among the cross-sectional studies, two found significant associations — one with children's FV intake (Shim et al., 2016) and the other with vegetable preference (Vollmer & Baietto, 2017); seven showed no statistically significant results (Chen et al., 2021; Entin et al., 2014; Kaukonen et al., 2019; Melbye et al., 2012, 2013; Quah et al., 2018; Taylor et al., 2017); and one found a negative association with FV intake (Kalantari & Doaei, 2014).

Both longitudinal studies found significant associations. Metcalfe and Fiese (2018) showed that preschoolers' involvement in food-related activities at 3 years predicted FV consumption at 4 years. Radtke et al. (2019) observed that children's involvement in food preparation increased their liking for vegetables, which in turn mediated vegetable consumption. The experimental study by van der Horst et al. (2014) showed that a single meal-preparation session led children to eat 76.1 % more salad than the control group.

### 3.5.3. Teachable moments: nutrition education and reasoning

Nutrition education involves parents sharing information about food to help guiding their children toward healthier food choices (Vaughn et al., 2016). Reasoning, on the other hand, refers to the use of explanations and logical arguments to persuade children to change their eating behaviors (Vaughn et al., 2016). While these two concepts are distinct (Vaughn et al., 2016), they overlap in their measurement tools and conceptual framework. For instance, telling a child a food will make them "strong and healthy" can be reasoning (persuasion) and nutrition education (a simplified health message). Given this overlap, we classify these practices as "Teachable Moments".

A total of 17 studies investigated the relationship between teachable moments and either children's fruit and vegetable consumption or their preference for these foods (Afonso et al., 2020; Hendy et al., 2009; Jordan et al., 2020; Kalantari & Doaei, 2014; Melbye et al., 2012, 2013; Melbye & Hansen, 2015; Papaioannou et al., 2013; Quah et al., 2018; Radtke et al., 2019; Shim et al., 2016; Taylor et al., 2017; Vaughn et al., 2017; Vereecken et al., 2004, 2005; Vollmer & Baietto, 2017; Zeinstra et al., 2010). Of these, one assessed fruit and vegetable preference (Vollmer & Baietto, 2017), another examined both vegetable consumption and preference (Radtke et al., 2019), and the remaining studies focused on the consumption of these foods. Only one was a longitudinal study (Radtke et al., 2019), while the others were cross-sectional. Fifteen studies assessed teachable moments through parental reports (Afonso et al., 2020; Hendy et al., 2009; Kalantari & Doaei, 2014; Melbye et al., 2012, 2013; Melbye & Hansen, 2015; Papaioannou et al., 2013; Quah et al., 2018; Radtke et al., 2019; Shim et al., 2016; Taylor et al., 2017; Vaughn et al., 2017; Vereecken et al., 2004; Vollmer & Baietto, 2017; Zeinstra et al., 2010); one relied on children's self-reports (Vereecken et al., 2005) and another one employed direct observation in a laboratory setting (Jordan et al., 2020).

Among the cross-sectional studies, three (Hendy et al., 2009; Shim et al., 2016; Vaughn et al., 2017) found a positive relationship between the use of "teachable moments" and higher fruit and/or vegetable consumption. In contrast, 13 studies (Afonso et al., 2020; Jordan et al., 2020; Kalantari & Doaei, 2014; Melbye et al., 2012, 2013; Melbye & Hansen, 2015; Papaioannou et al., 2013; Quah et al., 2018; Taylor et al., 2017; Vereecken et al., 2004, 2005; Vollmer & Baietto, 2017), including one longitudinal study (Radtke et al., 2019), did not reach statistical significance. Additionally, a study assessing the concept called "positive information" - which includes parental actions such as informing children about the health benefits of vegetables, emphasizing their taste, and demonstrating enjoyment of them - revealed that this practice actually predicted a decrease in child's vegetable consumption (N = 242; standardized $\beta = -0.13$; $p = 0.02$) (Zeinstra et al., 2010).

#### 3.5.4. Praise

Praise is a positive reinforcement delivered as parents' verbal feedback, used to encourage eating a specific food (e.g., a fruit or a vegetable) or trying new foods (Vaughn et al., 2016). Here we include only studies assessing praise as a standalone practice; studies combining praise with other strategies were classified under "Verbal and visual encouragement to eat".

Nine studies investigated the relationship between praise and child's consumption of fruit (Conlon et al., 2019; Rodríguez-Arauz & Ramírez-Esparza, 2022; Vereecken et al., 2004, 2009), vegetable (Jordan et al., 2020; Rodríguez-Arauz & Ramírez-Esparza, 2022; Vereecken et al., 2004, 2009), or pooled food groups combined (Afonso et al., 2020; Taylor et al., 2017; Vaughn et al., 2017; Vereecken, Haerens, et al., 2010). Of these, eight were cross-sectional (Afonso et al., 2020; Conlon et al., 2019; Jordan et al., 2020; Rodríguez-Arauz & Ramírez-Esparza, 2022; Taylor et al., 2017; Vaughn et al., 2017; Vereecken et al., 2004, 2009) and one was longitudinal (Vereecken, Haerens, et al., 2010). Seven studies assessed praise through parental reports (Afonso et al., 2020; Conlon et al., 2019; Taylor et al., 2017; Vaughn et al., 2017; Vereecken et al., 2004, 2009, 2010b), one combined parental reports and behavioral observations in natural settings (home) (Rodríguez-Arauz & Ramírez-Esparza, 2022), and another used direct observation in a laboratory setting (Jordan et al., 2020).

Two (Jordan et al., 2020; Vereecken et al., 2004) of the four studies (Jordan et al., 2020; Rodríguez-Arauz & Ramírez-Esparza, 2022; Taylor et al., 2017; Vereecken et al., 2004) that assessed the relationship between praise and fruit and/or vegetable consumption in younger children (2–7 years old) found a positive and significant relationship with child vegetable consumption. In contrast, no significant associations were observed in the three studies with older children (7–12 years old) (Conlon et al., 2019; Vereecken et al., 2009, 2010b) or in the two studies with broad age ranges (3–12 years old) (Afonso et al., 2020; Vaughn et al., 2017).

#### 3.5.5. Negotiation

Negotiation refers to the interactive process in which parents and children discuss food choices. This includes strategies such as agreeing on the consumption of new foods, even if the child initially dislikes them, determining portion sizes, and setting expectations for food consumption (O'Connor et al., 2017; Vaughn et al., 2016).

Four studies examined the relationship between negotiation practices and child's fruit and/or vegetable consumption (Rodríguez-Arauz & Ramírez-Esparza, 2022; Vereecken et al., 2004, 2009, 2010b). Among these, one study was longitudinal (Vereecken, Haerens, et al., 2010), while the others were cross-sectional. Three studies relied on parental reports (Vereecken et al., 2004, 2009; 2010b), while one combined parental reports and behavioral observations in natural settings (Rodríguez-Arauz & Ramírez-Esparza, 2022). Only one cross-sectional study found a significant association between negotiation and increased vegetable consumption (N = 1614; OR [95 %CI] = 1.23 [1.04, 1.45]) (Vereecken et al., 2009).

One longitudinal study (Vereecken, Haerens, et al., 2010) found that negotiation was positively associated with children's FV intake at baseline and remained so over four years after adjusting for other food-parenting practices and sociodemographics. However, the association was no longer significant once baseline intake was included in the model.

#### 3.5.6. Other practices supporting autonomy in child feeding

Some studies also examined other parental practices that support children's autonomy in feeding. These include whether parents allow their children to decide what and how much to eat (Kaar et al., 2016; Kaukonen et al., 2019; Kröller & Warschburger, 2008), the opportunities provided for food choices (Ha et al., 2022; Kaukonen et al., 2019), the value placed on children's opinions (Ha et al., 2022), and the parent's ability to respond to hunger and satiety cues (Taylor et al., 2017). Although these studies do not always assess the same practices - some focus on child control over feeding, others on feeding responsiveness, and some on the child's perception of parental support for autonomy - they all share a common goal, which is promoting children's ability to self-regulate their food intake. For this reason, all of these practices were grouped under the same topic. A summary of the main findings from each study is provided in Supplementary Table S4.

In the study conducted by Kröller and Warschburger (2008), mothers of children aged 3–6 years were assessed regarding their children's control over food choices and portion sizes. The findings indicated that greater child control was linked to a higher intake of FV (N = 219; $\beta = 0.305$, $t = 2.743$, $p = 0.007$). In Kaar et al. (2016), a study of parents of children aged 3–5 years, the practice labeled "child autonomy", assessing the child's control over decisions such as portion size and self-feeding, showed that, among boys, greater liking and consumption of fruit were associated with more autonomy granted (N = 210; β [95 % CI] = 0.32 [0.06, 0.58]).

Among parents of preschoolers, Taylor et al. (2017) found that feeding responsiveness (e.g., asking about hunger before offering food) was not significantly associated with children's FV intake. In contrast, Kaukonen et al. (2019) found that a practice labeled enhanced availability and autonomy support, which included making vegetables easily accessible and allowing child choice, was positively associated with daily vegetable consumption.

Finally, a Chinese study (Ha et al., 2022) conducted with parents and children aged 9–12 years, operationalizing the practice referred to as support for food autonomy through children's perceptions (e.g., opportunities to choose foods, knowing the reasons for rules), found that greater perceived autonomy was associated with higher fruit and vegetable consumption.

### 3.6. Meta-analysis results

A quantitative meta-analysis was conducted to examine the relationship between food parenting practices and children's fruit and vegetable consumption using two distinct models: one based on correlation coefficients (22 studies) and another one based on regression coefficients (13 studies). In the correlation-based model, all food parenting practices showed positive and statistically significant correlations with children's fruit and vegetable consumption; however, these correlations were classified as weak according to Cohen's classification (small: $0.10 \leq r < 0.30$) (Cohen, 2013). Additionally, high heterogeneity ($I^2 = 85.6$ %) was observed across studies assessing verbal and visual encouragement to eat. The meta-analysis results, including the tests for heterogeneity and publication bias, are presented in Table 2.

To complement the correlation analysis, a regression-based meta-analysis was conducted, providing effect sizes adjusted for potential confounding variables. As detailed in Table 3, this more robust model confirmed that the practices of verbal and visual encouragement to eat (K = 14; β [95 %CI] = 0.07 [0.02, 0.12]; $I^2 = 63.3$ %) and involvement (K = 5; β [95 %CI] = 0.10 [0.04, 0.16]; $I^2 = 0.0$ %) were associated with children's fruit and vegetable consumption, exhibiting a small effect size (Cohen, 2013).

Praise also showed a positive association with children's fruit and vegetable consumption; however, it did not reach statistical significance (K = 3; OR [95 %CI] = 1.07 [0.99, 1.15]; $I^2 = 0.0$ %). Teachable moments and negotiation were excluded from the analysis, as fewer than three studies were available for regression-based analyses. Forest plots for all parenting practices assessed are provided in the Supplementary File (Fig. S1–S15).

**Table 2**
Meta-analysis of food parenting practices aiming to increase fruit and vegetable consumption among children based on correlation coefficients (n = 22 studies included).

| Parenting practices | K | N | r (95 % CI) | T | Q (df, p-value) | $I^2$ (95 %CI) | $\tau^2$ (95 %CI) | Egger's t | Egger's p-value |
|---|---|---|---|---|---|---|---|---|---|
| Encouragement | 36 | 22,339 | 0.1699 (0.1299; 0.2099)*** | 7.62 | 242.63 (35, <0.0001) | 85.6 (81.0; 89.1) | 0.0101 (0.0050; 0.0183) | 0.344 | 0.7332 |
| Involvement | 13 | 4579 | 0.1289 (0.0895; 0.1648)*** | 6.40 | 14.25 (12, 0.2849) | 15.8 (0.0; 54.7) | 0.0019 (0.0000; 0.0062) | 1.31 | 0.2168 |
| Teachability moments | 11 | 4079 | 0.1096 (0.0665; 0.1527)** | 4.99 | 11.62 (10, 0.3112) | 13.9 (0.0; 54.5) | 0.0022 (0.0000; 0.0094) | −0.056 | 0.9564 |
| Praise | 13 | 1597 | 0.1016 (0.0149; 0.1884)** | 2.30 | 12.83 (12, 0.3816) | 6.5 (0.0; 59.4) | 0.0078 (0.0000; 0.0214) | −0.034 | 0.9733 |
| Negotiation | 11 | 1357 | 0.1598 (0.0484; 0.2713)* | 2.81 | 7.71 (10, 0.6574) | 0.0 (0.0; 60.2) | 0.0114 (0.0000; 0.0412) | 2.131 | 0.0589 |

**K** = number of studies included in the meta-analysis for each parenting practices; **N** = total sample size considering all included studies; **r** = Correlation coefficient; **95 %CI** = 95 % confidence interval; t = t-statistic for the random-effects model and its corresponding p-value; **Q (df, p-value)** = Cochran's Q test for heterogeneity, degrees of freedom (df), and corresponding p-value; **$I^2$(95 %CI)** = percentage of total variation due to heterogeneity, with a 95 % confidence interval; **$\tau^2$ ($tau^2$)** = estimate of variance between study effects in the meta-analysis, reflecting the dispersion of effect sizes; **Egger's t** = statistical test to assess publication bias; statistically significant results suggest potential bias in the meta-analysis. *$p < 0.01$; **$p < 0.001$; ***$p < 0.0001$.

**Table 3**
Meta-analysis of food parenting practices aiming to increase fruit and vegetable consumption among children based on regression coefficients (n = 12 studies included).

| Parenting practices | K | N | Estimate (95 %CI) | T | Q (df, p-value) | $I^2$ (95 %CI) (%) | $\tau^2$ (95 %CI) | Egger's t | Egger's p-value |
|---|---|---|---|---|---|---|---|---|---|
| Encouragement | 14 | 6488 | 0.07 (0.02; 0.12)* | 2.73 | 35.42 (13, <0.001) | 63.3 (34.8; 79.3) | 0.0052 (0.0008; 0.0163) | 0.68 | 0.5096 |
| Involvement | 5 | 1516 | 0.10 (0.04; 0.16)** | 3.26 | 1.12 (4, 0.8905) | 0.0 (0.0; 79.2) | 0.0004 (0.0000; 0.0095) | 0.352 | 0.7482 |
| Praise | 3 | 3369 | 1.07 (0.99; 1.15) | 3.70 | 0.57 (2, 0.7528) | 0.0 (0.0; 89.6) | 0.0002 (0.0000; 0.0383) | 0.492 | 0.7090 |

**K** = number of studies included in the meta-analysis for each parenting. Practices; **N** = total sample size considering all included studies; **Estimate (95 %CI)** = For Encouragement and Involvement, the estimates were based on linear regression coefficients, while for praise, the estimate was based on logistic regression Odds Ratios; **95 %CI** = 95 % confidence interval; **t** = t-statistic for the random-effects model and its corresponding p-value; **Q (df, p-value)** = Cochran's Q test for heterogeneity, degrees of freedom (df), and corresponding p-value; **$I^2$(95 %CI)** = percentage of total variation due to heterogeneity, with a 95 % confidence interval; **$\tau^2$ ($tau^2$)** = estimate of variance between study effects in the meta-analysis, reflecting the dispersion of effect sizes; **Egger's t** = statistical test to assess publication bias; significant results suggest potential bias in the meta-analysis.
*$p < 0.05$; **$p < 0.001$.

### 3.6.1. *Subgroup analyses*

The studies evaluating verbal and visual encouragement to eat showed variability, prompting subgroup analyses. Analyses were stratified to evaluate whether heterogeneity was influenced by country of study, children's age group (2–6 years and 7–12 years), the method or instrument used to assess food parenting practices, the type of outcome (food preference or consumption), the nature of the outcome (separate or combined fruit and vegetable consumption), the method used to assess dietary intake, and report perspective (parent- or child-report). Based on the correlation coefficients, heterogeneity appeared to be influenced only by country of study and the instruments used to assess both food parenting practices and dietary intake.

As detailed in Table 4, the country-level subgroup analysis revealed that heterogeneity remained high in some strata, though not all, suggesting a multifaceted influence on the results (e.g., geographic and cultural differences, as well as variations in instruments used to assess parenting practices and dietary intake). For instance, heterogeneity remained high in estimates from Iceland ($I^2$ = 86.7 %), Belgium ($I^2$ = 79.3 %), and Norway ($I^2$ = 76.4 %), while it decreased substantially in Israel, Poland, the United States, and the United Kingdom ($I^2 \approx 0$ %). Notably, these four countries also showed the largest pooled effect sizes: Israel (K = 2; r [95 %CI] = 0.31 [0.12, 0.49]), Poland (K = 2; r [95 %CI] = 0.27 [0.23, 0.30]), the United Kingdom (K = 2; r [95 %CI] = 0.24 [0.17, 0.30]), and the United States (K = 5; r [95 %CI] = 0.25 [0.16, 0.34]). These $I^2$ values should be interpreted with caution, as in three of these countries the estimates come from a single publication and therefore reflect the same context.

The subgroup analysis indicated that the instrument used to assess verbal and visual encouragement to eat contributed to heterogeneity, with pooled effects as follows: CFPQ (K = 6; r [95 %CI] = 0.19 [0.11; 0.27]), Pro Children Project instrument (K = 19; r [95 %CI] = 0.20 [0.15, 0.25]), and PFPQ (K = 3; r [95 %CI) = 0.17 [0.07, 0.28]) (Table 4). However, even within subgroups of the most commonly used instruments, such as the CFPQ and PFPQ, heterogeneity remained moderate to high ($I^2$ = 56.9 % and $I^2$ = 86.2 %, respectively). This suggests that variability may stem not only from instrument choice but also from the multifaceted nature of the verbal and visual encouragement to eat construct. For example, the PFPQ, which displayed the greatest within-subgroup heterogeneity, combines verbal prompting, praise, and attractive food presentation into a single subscale. By grouping different behaviors under a single label, the instrument may capture inherent variability that, when applied across different cultural contexts and samples, cannot be explained by instrument stratification alone (Morris, 2023).

In the subgroup analysis by dietary assessment instruments, the largest statistically significant pooled effect sizes were observed in studies using frequency-based FFQ (K = 26; r [95 %CI] = 0.19 [0.14, 0.23]; $I^2$ = 83.6 %) and quantitative-based FFQ (K = 7; r [95 %CI] = 0.14 [0.04, 0.23]; $I^2$ = 85.9 %) (Table 4). By contrast, 24-h recalls and EMA were used in fewer studies, even though they may provide more accurate estimates of actual intake.

The subgroup analysis based on regression coefficients (Table 5) revealed similar and additional findings. The study country and the assessment methods continued to be important sources of variability. In addition, child age significantly moderated the association between verbal and visual encouragement to eat and FV consumption. For children aged 2–6 years, the pooled effect was positive and statistically significant (K = 6; β [95 %CI] = 0.11 [0.06, 0.15]), with high consistency across studies ($I^2$ = 0 %). In contrast, for children aged 7–12 years, the pooled estimates were not statistically significant (K = 7; β [95 %CI

**Table 4**
Subgroup analysis of the relationship between parental encouragement and children's fruit and vegetable consumption (n = 17 included studies), based on correlation coefficients.

| Subgroup Analysis | | K | N | r (95 % CI) | Q | $I^2$ (%) | $\tau^2$ |
|---|---|---|---|---|---|---|---|
| **Country of study** | Austria (Sandvik et al., 2007) | 1 | 991 | −0.0300 (−0.0923; 0.0323) | 0.00 | – | – |
| | Belgium (De Bourdeaudhuij et al., 2005; C. Vereecken, Rovner et al., 2010) | 4 | 1652 | 0.1098 (−0.0471; 0.2666) | 14.48 | 79.3 | 0.0196 |
| | Belgium and the Netherlands (Wind et al., 2006) | 2 | 4896 | 0.2041*** (0.1619; 0.2463) | 2.47 | 59.5 | 0.0005 |
| | China (Ha et al., 2022) | 1 | 1502 | 0.0500 (−0.0005; 0.1005) | 0.00 | – | – |
| | Denmark (De Bourdeaudhuij et al., 2005) | 2 | 128 | 0.1503 (−0.0242; 0.3247) | 0.11 | 0.0 | <0.0001 |
| | Germany (Haβ & Hartmann, 2018) | 1 | 702 | −0.0120 (−0.0861; 0.0621) | 0.00 | – | – |
| | Iceland (Kristjansdottir et al., 2006) | 2 | 2358 | 0.2252*** (0.1216; 0.3288) | 7.52 | 86.7 | 0.0048 |
| | Israel (Entin et al., 2014) | 2 | 126 | 0.3081** (0.1230; 0.4933) | 0.76 | 0.0 | 0.0031 |
| | the Netherlands (Rodenburg et al., 2014) | 1 | 1275 | 0.0700*(0.0152; 0.1248) | 0.00 | – | – |
| | Norway (De Bourdeaudhuij et al., 2005; Melbye et al., 2012; Sandvik et al., 2007) | 5 | 2844 | 0.1904*** (0.1083; 0.2724) | 16.93 | 76.4 | 0.0051 |
| | Poland (Wolnicka et al., 2015) | 2 | 2510 | 0.2650*** (0.2272; 0.3029) | 0.10 | 0.0 | <0.0001 |
| | Portugal (Afonso et al., 2020; De Bourdeaudhuij et al., 2005) | 3 | 229 | 0.0961 (−0.0818; 0.2741) | 3.49 | 42.7 | 0.0111 |
| | Spain (De Bourdeaudhuij et al., 2005; Sandvik et al., 2007) | 3 | 1453 | 0.1781 (−0.0222; 0.3783) | 7.87 | 74.6 | 0.0240 |
| | United Kingdom (McGowan et al., 2012) | 2 | 868 | 0.2350*** (0.1702; 0.2998) | 0.02 | 0.0 | <0.0001 |
| | United States (Lopez et al., 2022; Shim et al., 2016; Vaughn et al., 2017) | 5 | 805 | 0.2504*** (0.1627; 0.3381) | 3.82 | 0.0 | 0.0026 |
| **Method of Food Parenting Practices Assessment** | Caregiver's Feeding Styles Questionnaire (C. Vereecken, Rovner et al., 2010) | 2 | 1510 | 0.0050 (−0.0981; 0.1081) | 4.57 | 78.1 | 0.0042 |
| | Comprehensive Feeding Practices Questionnaire (Entin et al., 2014; Melbye et al., 2012; Shim et al., 2016) | 6 | 2350 | 0.1889*** (0.1123; 0.2656) | 11.60 | 56.9 | 0.0052 |
| | Ecological Momentary Assessment (Lopez et al., 2022) | 2 | 44 | 0.2159 (−0.0869; 0.5187) | 0.09 | 0.0 | 0.0002 |
| | HomeSTEAD's Family Food Practices Survey (Afonso et al., 2020; Vaughn et al., 2017) | 2 | 238 | 0.1682 (−0.2401; 0.5765) | 11.51 | 91.3 | 0.0788 |
| | Instrument developed for the Pro Children Project (De Bourdeaudhuij et al., 2005; Kristjansdottir et al., 2006; Sandvik et al., 2007; Wind et al., 2006; Wolnicka et al., 2015) | 19 | 13,850 | 0.2015*** (0.1544; 0.2487) | 100.64 | 82.1 | 0.0064 |
| | Parent-reported Social Support for Child's Fruit and Vegetable Intake (Haβ & Hartmann, 2018) | 1 | 702 | −0.0120 (−0.0861; 0.0621) | 0.00 | – | – |
| | Parental Feeding Practice Questionnaire (McGowan et al., 2012; Rodenburg et al., 2014) | 3 | 2143 | 0.1741** (0.0655; 0.2827) | 14.54 | 86.2 | 0.0075 |
| | Vereecken et al., 2004 adaptation (Ha et al., 2022) | 1 | 1502 | 0.0500 (−0.0005; 0.1005) | 0.00 | – | – |
| **Consumption Assessment Method** | Food Frequency Questionnaire (FFQ), with a focus on the frequency of consumption (Afonso et al., 2020; De Bourdeaudhuij et al., 2005; Ha et al., 2022; Kristjansdottir et al., 2006; Melbye et al., 2012; Sandvik et al., 2007; Shim et al., 2016; Vaughn et al., 2017; Wind et al., 2006; Wolnicka et al., 2015) | 26 | 17,814 | 0.1867*** (0.1430; 0.2304) | 152.50 | 83.6 | 0.0085 |
| | FFQ with Estimated Quantity (predefined portions or quantified in grams) (Entin et al., 2014; McGowan et al., 2012; Rodenburg et al., 2014; C. Vereecken, Rovner et al., 2010) | 7 | 3779 | 0.1445** (0.0393; 0.2498) | 42.48 | 85.9 | 0.0162 |
| | 24-Hour Recall (Haβ & Hartmann, 2018) | 1 | 702 | −0.0120 (−0.0861; 0.0621) | 0.00 | – | – |
| | Ecological Momentary Assessment (Lopez et al., 2022) | 2 | 44 | 0.2159 (−0.0869; 0.5187) | 0.09 | 0.0 | 0.0002 |

**K** = number of studies included in the meta-analysis for each parenting practices; **N** = total sample size considering all included studies; **r** = correlation coefficient; **95 %CI** = 95 % Confidence Interval; **Q** = Cochran's Q test for heterogeneity; $\mathbf{I^2}$ = percentage of total variation due to heterogeneity; $\boldsymbol{\tau^2}$ **(tau²)** = estimate of variance between study effects in the meta-analysis, reflecting the dispersion of effect sizes.*p < 0.05; **p < 0.01; **<0.0001.

**Table 5**
Subgroup analysis of the relationship between encouragement and children's fruit and vegetable consumption (n = 8 included studies), based on regression coefficients.

| Subgroup Analysis | | K | N | β (95 % CI) | Q | $I^2$ (%) | $\tau^2$ |
|---|---|---|---|---|---|---|---|
| **Country** | Belgium (Vereecken, Rovner, & Maes, 2010) | 2 | 1510 | 0.0958** (0.0387; 0.1529) | 0.46 | 0.0 | 0.0001 |
| | China (Ha et al., 2022; Qiu et al., 2023) | 5 | 1986 | 0.0075 (−0.0503; 0.0652) | 4.92 | 18.7 | 0.0017 |
| | New Zealand (Haszard et al., 2015) | 1 | 196 | 0.1976** (0.0659; 0.3293) | 0.00 | – | – |
| | United States (Couch et al., 2014; Heredia et al., 2016; Shim et al., 2016; Vollmer & Baietto, 2017) | 6 | 2796 | 0.0901* (0.0175; 0.1628) | 16.87 | 70.4 | 0.0047 |
| **Age** | 2–6 years (Shim et al., 2016; Vereecken, Rovner, & Maes, 2010; Vollmer & Baietto, 2017) | 6 | 2438 | 0.1058**** (0.0612; 0.1505) | 3.08 | 0.00 | 0.0007 |
| | 7–12 years (Couch et al., 2014; Ha et al., 2022; Heredia et al., 2016; Qiu et al., 2023) | 7 | 3854 | 0.0218 (−0.0584; 0.1021) | 18.52 | 67.6 | 0.0053 |
| | Both (Haszard et al., 2015) | 1 | 196 | 0.1976** (0.0659; 0.3293) | 0.00 | – | – |
| **Method of Food Parenting Practices Assessment** | Caregiver's Feeding Styles Questionnaire (Vereecken, Rovner, & Maes, 2010) | 2 | 1510 | 0.0958** (0.0387; 0.1529) | 0.46 | 0.0 | 0.0001 |
| | Comprehensive Feeding Practices Questionnaire (Haszard et al., 2015; Shim et al., 2016; Vollmer & Baietto, 2017) | 5 | 1124 | 0.1318**** (0.0613; 0.2022) | 3.38 | 0.0 | 0.0017 |
| | Instrument developed for the Pro Children Project (Couch et al., 2014) | 1 | 699 | 0.1700*** (0.0852; 0.2548) | 0.00 | – | – |
| | Questionnaire developed for the study (Heredia et al., 2016) | 1 | 1169 | −0.0360 (−0.1124; 0.0404) | 0.00 | – | – |
| | Parental Feeding Practice Questionnaire (Qiu et al., 2023) | 2 | 484 | −0.0864 (−0.2616; 0.0887) | 0.06 | 0.0 | <0.0001 |
| | Vereecken et al., 2004 adaptation (Ha et al., 2022) | 3 | 1502 | 0.0183 (−0.0352; 0.0718) | 3.33 | 40.0 | 0.0011 |
| **Consumption Assessment Method** | Food Frequency Questionnaire (FFQ), with a focus on the frequency of consumption (Afonso et al., 2020; De Bourdeaudhuij et al., 2005; Ha et al., 2022; Kristjansdottir et al., 2006; Melbye et al., 2012; Sandvik et al., 2007; Shim et al., 2016; Vaughn et al., 2017; Wind et al., 2006; Wolnicka et al., 2015) | 6 | 3303 | 0.0424 (−0.0421; 0.1268) | 15.46 | 67.7 | 0.0049 |
| | FFQ with estimated consumed quantity (predefined portions or quantified in grams) (Entin et al., 2014; McGowan et al., 2012; Rodenburg et al., 2014; C. Vereecken, Rovner et al., 2010) | 2 | 1510 | 0.0958** (0.0387; 0.1529) | 0.46 | 0.0 | 0.0001 |
| | 24-Hour Recall (Haβ & Hartmann, 2018) | 1 | 699 | 0.1700*** (0.0852; 0.2548) | 0.00 | – | – |
| | Specific score (Haszard et al., 2015) | 1 | 196 | 0.1976** (0.0659; 0.3293) | 0.00 | – | – |
| | Food preference questionnaire (Vollmer et al., 2017; Qiu et al., 2023) | 4 | 780 | 0.0076 (−0.1052; 0.1204) | 1.90 | 0.0 | 0.0024 |

**K** = number of studies included in the meta-analysis for each parenting practices; **N** = total sample size considering all included studies; β = standardized regression coefficient; **95 %CI** = 95 % Confidence Interval; **Q** = Cochran's Q test for heterogeneity; $\mathbf{I^2}$ = percentage of total variation due to heterogeneity; $\boldsymbol{\tau^2}$ **(tau²)** = estimate of variance between study effects in the meta-analysis, reflecting the dispersion of effect sizes.*p < 0.05; **p < 0.01; ***p < 0.001; ****<0.0001.

= 0.02 [−0.06, 0.10]), and heterogeneity was moderate ($I^2$ = 67.6 %).

It is important to note that, although stratifying the studies helped identify sources of variability, heterogeneity persisted in some subgroups. This suggests that the relationship examined may be influenced by other unmeasured contextual and methodological variables (e.g., subtler cultural differences within countries, the multifaceted operationalization of verbal and visual encouragement to eat) or by their possible interactions. However, the limited number of studies prevents more robust subgroup analyses that could assess the combined effects of these variables.

### 3.6.2. *Publication bias and sensitivity analysis*

No publication bias was detected, as indicated by the non-significant values of Egger's test for all parental practices analyzed (Tables 2 and 3) and by the relatively symmetric distribution of studies in the funnel plots (Supplementary Fig. S16–S23). Although the possibility of publication bias cannot be entirely ruled out, especially in analyses with a smaller number of studies, our main results were confirmed by a sensitivity analysis. This analysis, detailed in Supplementary Fig. S24–S31, demonstrated that the associations remained statistically significant after the exclusion of studies that had an influence on the overall effect.

## 4. Discussion

This systematic review aims to build on existing evidence and complement the understanding of the relationship between parental autonomy-supportive food practices and fruit and vegetable consumption in children aged 2–12 years. In the descriptive synthesis of individual studies, verbal and visual encouragement to eat emerged as the most investigated practice, with a majority of studies demonstrating significant positive relationships with children's fruit and vegetable consumption. Parental involvement was also positively associated with children's intake of fruit and vegetable, particularly in longitudinal and experimental studies; however, results were heterogeneous in cross-sectional studies. Other practices, such as teachable moments, praise, and negotiation, yielded more inconclusive findings. Nevertheless, the meta-analysis indicated that, in the correlation model, all practices were positively, albeit weakly, related to children's fruit and vegetable intake.

The association for encouragement and involvement remained significant in the regression model, but the observed effect sizes were also weak.

This modest impact suggests that, while parental autonomy-supportive food practices may create a more positive eating environment (Scaglioni et al., 2018; Vaughn et al., 2016), they seem to explain only a small portion of the variability in children's FV consumption. In light of this, some explanations can be proposed. First, we can consider the bidirectional nature of parent-child interactions, which can be described using the "parent response" or "child effects" models (Warkentin et al., 2020). Parents adjust their parenting strategies based on their children's characteristics and behaviors (Jansen et al., 2017), with parents, for example, reducing their verbal and visual encouragement to eat if their child shows intrinsic motivation or interest in consuming FV. On the other hand, although this practice is a less-controlling approach to promoting, it may be ineffective for children who are averse to the taste or texture of certain foods. This resistance can prevent verbal and visual encouragement to eat from having the desired effect, as food neophobia has been shown to be a significant negative predictor of FV preference and consumption, outweighing the direct influence of parental control (Kaar et al., 2016; Wardle et al., 2005).

The low magnitude of the combined effects for all practices further reinforces the multifactorial nature of fruit and vegetable consumption (Scaglioni et al., 2018; Stok et al., 2017). Child intake is influenced by a host of factors, including food availability, parental modeling, and socioeconomic variables (Pearson et al., 2009; Rasmussen et al., 2006). However, a significant limitation identified in this review was the inconsistent adjustment for such confounding variables across studies (Supplementary Table S4). While some studies controlled for socioeconomic and behavioral factors (Al-Buobayd et al., 2023; Couch et al., 2014; Kaar et al., 2016; Kaukonen et al., 2019; Kristjansdottir et al., 2006, 2009; Kröller & Warschburger, 2008; Papaioannou et al., 2013; Quah et al., 2018; Radtke et al., 2019; Rodenburg et al., 2014; Sleddens et al., 2014; Taylor et al., 2017; Vereecken et al., 2004, 2010b; Wind et al., 2006; Zeinstra et al., 2010), others did not adjust for any confounders (Afonso et al., 2020; De Bourdeaudhuij et al., 2005; Entin et al., 2014; Melbye & Hansen, 2015; Rodríguez-Arauz & Ramírez-Esparza, 2022; Vaughn et al., 2017; Vereecken et al., 2005; Wolnicka et al., 2015), which may have contributed to the variability in results. To guide future research, we propose an adaptation of the conceptual model from Vaughn et al. (2016) to help identify and account for potential confounders and mediators (Fig. 1).

Verbal and visual encouragement to eat practices showed substantial variability between studies that was not fully explained by subgroup analyses. Part of this heterogeneity was tied to the countries in which studies were conducted, as our subgroup analysis revealed significant differences in the magnitude of the associations by country. This finding reinforces that food parenting practices differ across cultural contexts (Rodríguez-Arauz & Ramírez-Esparza, 2022; Vaughn et al., 2016). For example, a study conducted in the United States (Rodríguez-Arauz & Ramírez-Esparza, 2022) found that White European caregivers reported and behaviorally demonstrated more verbal and visual encouragement to eat than Latino caregivers, a practice that may be aligned with mainstream American values of independence and autonomy. In another study in the United Kingdom (Gu et al., 2017), South Asian and Black Afro-Caribbean British parents scored higher than White British families on pressure to eat, emotional eating, and instrumental feeding, while Black Afro-Caribbean parents scored lower on monitoring. These findings illustrate how broader cultural values can shape different food parenting approaches.

Two main sources of variability in the studies assessing verbal and visual encouragement to eat were the operationalization of these practices and the methods used to evaluate dietary intake. Various methods were employed, including FFQs, 24-h recalls, direct food weighing, and dietary intake markers. Furthermore, the operationalization of verbal and visual encouragement to eat itself varied significantly across studies. Some studies employed broad questionnaires that captured multiple dimensions under a single encouragement construct, encompassing both autonomy-supportive practices (e.g., praise) and structure-related practices, such as those using the PFPQ. Other studies utilized the instrument developed for the Pro Children Project, focusing specifically on encouragement for fruit and vegetable consumption. A third group used the CFPQ to assess encouragement for healthy eating in general, without a specific focus on fruit and vegetable, as detailed in Supplementary Table S5. This variation in methods of dietary intake assessment and the operationalization of the encouragement construct may have influenced the magnitude and direction of observed associations.

The meta-analysis based on regression coefficients also revealed significant variation in the influence of verbal and visual encouragement to eat across age groups, with stronger associations observed among younger children (2–6 years) compared to older ones (7–12 years). This aligns with the findings of Yee et al. (2017), who noted age-dependent effects of food parenting practices. Younger children may respond more to direct encouragement as they are still forming their eating habits, while older children may rely less on parental prompts due to established preferences, greater autonomy, and the increasing influence of external factors such as school and peers (Balantekin et al., 2020). However, the correlation-based meta-analysis did not detect significant age-related heterogeneity. This difference likely arises because regression models adjust for confounding variables, increasing sensitivity to detect differences between subgroups. Correlation analyses, which do not account for these covariates, may obscure age effects by blending overlapping influences.

The literature suggests that children's acceptance and preference for fruit and vegetable may differ (Johnson, 2016). Children often exhibit an innate aversion to bitter tastes, which are more common in vegetables than fruit (Anzman-Frasca & Ehrenberg, 2018; Johnson, 2016). In this regard, vegetable acceptance is usually considered more challenging and may require more persistent parental strategies (Johnson, 2016). Given this underlying difference in acceptance between fruit and vegetable, it would be reasonable to expect the effect size of verbal and visual encouragement to eat practices to vary depending on the nature of the outcome (fruit or vegetable). However, in our meta-analysis, when evaluating the effect of parental encouragement, we did not find a statistically significant difference in effect size when the analysis was conducted separately for fruit versus vegetable consumption. This finding suggests that, in the included studies, the way verbal and visual encouragement to eat and child dietary intake were assessed — predominantly through caregiver self-report questionnaires for parental practices and FFQs for child intake — may not be sufficiently sensitive to capture these nuances.

Furthermore, food parenting practices may be influenced by the caregiver's sex, as described by Lozano-Casanova et al. (2024). Such differences can affect how mothers and fathers apply autonomy-supportive practices. Reviews have indicated that fathers are more likely to adopt coercive feeding strategies (Khandpur et al., 2014; Lozano-Casanova et al., 2024), while mothers tend to engage more in structure practices and autonomy support (Philippe et al., 2022). Although this review initially planned to conduct stratified analyses by sex, the limited availability of data made this approach unfeasible. The predominance of mothers in the sample reflects the historical trend that child feeding is considered a maternal responsibility, a role linked to gender stereotypes in which women are associated with caregiving and men with protective roles (Mallan et al., 2013; Pakaluk & Price, 2020). Given the growing involvement of fathers in childcare and feeding (Khandpur et al., 2014; Lozano-Casanova et al., 2024), future research must aim to include more gender-balanced samples and conduct gender-disaggregated analyses.

In contrast to the variability observed in verbal and visual encouragement to eat practices, child involvement in food activities showed a more consistent positive association, with low between-study heterogeneity. This finding highlights its potential as an autonomy-supportive strategy. The underlying mechanism may be what has been termed the IKEA effect, where active participation increases the value attributed to an activity (Norton et al., 2012; Radtke et al., 2019). In this context, when children participate in food-related activities, they may feel more motivated to try and consume the foods they helped prepare (Ng et al., 2022). Moreover, such involvement provides opportunities for sensory exploration, skill development, and strengthening family bonds, all of which can foster a positive relationship with food (Sandell et al., 2016). This approach may also support children's basic psychological needs for relatedness, competence, and autonomy—key elements in internalizing parental norms (Di Pasquale & Rivolta, 2018).

Regarding praise, teachable moments, and negotiation practices, the associations were less consistent. In the correlation-based meta-analysis, all showed positive relationships. However, the synthesis of regression coefficients for praise did not reach statistical significance ($p = 0.07$), likely due to the small number of studies ($K = 3$). Teachable moments and negotiation practices could not be included in this synthesis because of lack of studies with adjusted coefficients. Given these limitations, the positive correlations should be interpreted with caution. This highlights the need for methodologically rigorous studies with larger samples and adjusted analyses to clarify the role of these practices on children's FV consumption.

Finally, a synthesis of individual studies suggests that other practices supporting children's autonomy—characterized by a feeding environment that offers options, allows children to make choices about what and how much to eat, and promotes awareness and respect for the child's hunger and satiety cues — were associated with greater child fruit and vegetable consumption. These strategies combine structure (e.g., providing healthy options) with responsiveness to the child's needs, can foster healthier eating behaviors, and may also support children's development of self-regulation around eating (Balantekin et al., 2020). On the other hand, Johnson and Birch (1994) demonstrated that greater maternal control over the child's eating was associated with a lower child ability to self-regulate intake. In this sense, it is plausible to believe that strategies that provide structure and support for the child's decision-making may have the opposite effect—helping the child feel autonomous and promoting self-regulation of their eating behavior.

## 5. Strengths and limitations

The study's strengths include expanding knowledge on the relationship between food parenting practices that support autonomy and children's fruit and vegetable consumption. Although primarily based on cross-sectional studies, it highlights gaps in the literature and contributes to the formulation of new hypotheses. Efforts were made to maximize the use of available data from the included studies. In addition to conducting meta-analyses based on correlation coefficients, the review was complemented by meta-analyses based on regression coefficients. The review followed rigorous methodological standards and provides a robust quantitative synthesis of the available evidence. Furthermore, this systematic review employed a search methodology across six databases, supplemented by Google Scholar® screening and manual reference checking of included studies to ensure comprehensive coverage of the literature.

However, this review has some limitations. One limitation is the lack of geographical and cultural diversity among the identified studies. The majority of studies (92 %) were conducted in high-income countries, predominantly in North America and Europe. This geographical concentration is noteworthy, given that food parenting practices are culturally embedded. Consequently, the findings of this review may have limited generalizability to low- and middle-income nations, where eating environments and parenting norms can differ. Additionally, the diversity of instruments used to evaluate food parenting practices and dietary intake, along with the bi-directional nature of parent-child interactions, may have influenced the inconsistency of the results.

It is important to note the methodological limitations of the primary studies. First, there is a heavy reliance on self-report measures for both food parenting practices and child dietary intake, making them susceptible to recall and social desirability bias. Another limitation is the composition of the study samples, as 39 (73.6 %) studies predominantly or exclusively included mothers. This lack of father involvement limited our ability to conduct analyses stratified by caregiver sex. Furthermore, many studies did not consider important confounding variables (e.g., food availability and accessibility at home, child temperament and picky eating behavior), which may have affected the observed associations. Studies also did not take the child's pubertal stage into account. This point is particularly relevant for children in the older age range of our review (7–12 years), as chronological age is not an adequate proxy for pubertal development (Geary et al., 2025). The absence of assessment or reporting of pubertal status in primary studies limits our understanding of how food parenting practices may interact with the biological changes associated with pubertal development, which differ between boys and girls (Geary et al., 2025).

## 6. Conclusion

The results of this systematic review and meta-analysis suggest that parental strategies such as verbal and visual encouragement to eat, as well as involvement, are associated with children's fruit and vegetable intake, although the effect sizes are small. Additionally, verbal and visual encouragement to eat practices varied by study country, child age group, and instruments used for both the assessment of parental food practices and child food consumption. Other parental practices, such as teachable moments, praise, and negotiation, were correlated with children's fruit and vegetable consumption, though effect sizes were small. It is important to note, however, that this evidence is derived predominantly from cross-sectional studies and conducted in high-income countries.

## 7. Implications

Although the effect sizes identified in this meta-analysis are small and are primarily derived from cross-sectional studies, our findings may offer potential directions for families, health professionals, and public policies. Parents can promote children's FV consumption through verbal and visual encouragement without pressure, as well as by actively involving them in meal planning and preparation. Health professionals, in turn, can support caregivers in adopting more responsive and structured feeding practices. Finally, these results could be considered for incorporation into national child nutrition guidelines and healthy-eating promotion campaigns.

We suggest that future studies should adopt conceptual or theoretical models (O'Connor et al., 2017; Vaughn et al., 2016) to ensure consistency in the terminology and definitions of food parenting practices. Additionally, we suggest the stratification of the analysis of parental practices by the child's age group whenever possible, aiming to capture the nuances of child development and its interactions with feeding practices. Future research should also consider relevant moderating factors, such as personal characteristics (e.g. child temperament or appetitive traits) and contextual factors (e.g. availability and accessibility of food at home), aiming to properly control for important confounding factors. Well-designed longitudinal or intervention studies are highly recommended, as they are extremely useful in better understanding the causal relationships and the effects of parental food practices on children's fruit and vegetable consumption. It is also important to highlight the need for research in low- and middle-income countries and in ethnically diverse populations to broaden the understanding of cultural variations in parental feeding practices. Finally, as new studies are published, future meta-analyses should aim for more balanced subgroups regarding the number of studies and consider the combined influence of specific contextual and methodological variables in subgroup analysis.

## 8. Ethical clearance

Not applicable, because this is a review paper.

## CRediT authorship contribution statement

**Elisama Costa Lopes:** Writing – review & editing, Writing – original draft, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Priscylla Rodrigues Vilella:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Paula Ruffoni Moreira:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Sarah Warkentin:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Alexandre Siqueira Guedes Coelho:** Writing – review & editing, Software, Methodology, Formal analysis. **Géssica Mercia de Almeida:** Writing – review & editing, Supervision, Project administration, Methodology, Conceptualization. **Matias Noll:** Writing – review & editing, Methodology, Conceptualization. **Raquel Machado Schincaglia:** Writing – review & editing, Methodology, Conceptualization. **Karine Anusca Martins:** Writing – review & editing, Supervision, Project administration, Methodology, Conceptualization.

## Ethical statement and submission declaration

This study is a systematic review and meta-analysis based exclusively on previously published studies. Therefore, ethical approval and informed consent were not required.

By submitting this manuscript, the authors declare that:

- The work described has not been published previously, except as a preprint, abstract, published lecture, academic thesis, or registered report.
- The manuscript is not under consideration for publication elsewhere.
- Its publication is approved by all authors and, implicitly or explicitly, by the responsible authorities where the work was carried out.
- If accepted, the manuscript will not be published elsewhere in the same form, in English or any other language, including electronically, without the written consent of the copyright holder.

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## Declaration of competing interest

The authors declare that they have no competing interests.

I have nothing to declare.

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## Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2025.108389.

## Data availability

Data will be made available on request.

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