Plating up appropriate portion sizes for children: a systematic review of parental food and beverage portioning practices


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Plating up appropriate portion sizes for children: a systematic review of parental food and beverage portioning practices

Summary

Consumption of larger portion sizes is associated with higher energy intake and weight status in children. As parents play a pivotal role in child feeding, we synthesized literature on ‘parental portioning practices’ using a mixed methods systematic design to inform future strategies addressing portion sizes served to children. Electronic databases PubMed, EMBASE, SCOPUS, PsycINFO and CINAHL Plus were searched. Two reviewers independently screened 385 abstracts and assessed 71 full-text articles against eligibility criteria: studies assessing portioning of foods or beverages by parent(s) with ≥1 child aged 2–12 years. Narrative synthesis of 14 quantitative studies, found portion sizes parents serve vary substantially and are influenced by amounts parents serve themselves, perceived child hunger, and parent and child body size. Thematic synthesis of 14 qualitative studies found parents serve the portion sizes they learn to be appropriate for their child to be fed. Portioning is influenced by parents’ desires for a healthy child with a balanced diet. Future guidance on appropriate portion sizes for children would ideally present recommended portion sizes for first serving, incremental with age. Future research is however, needed to assess the adoption and efficacy of providing such guidance to families.
**Introduction**

Childhood overweight and obesity remains a global public health challenge. The sizes in which commercially produced foods and beverages are sold have increased in recent decades (1-3), as have the portion sizes children consume, in particular, energy-dense foods and beverages (e.g. crisps, cakes, biscuits, ice-creams, and sugar-sweetened beverages) (4, 5). Of primary concern, is children’s consumption of such foods and beverages in larger portion sizes, as this is associated with higher energy intake and body size (6-8).

The mechanism behind these observations has been termed the ‘portion size effect’, whereby, serving larger portion sizes increases the volume of a food or beverage consumed. In children, doubling the portion size served increases the volume consumed by approximately 20%, although effects vary by child age and weight status (9, 10). Effects are also exacerbated by energy density, having an additive effect to portion size (i.e. children consume more when served a larger portion size and more again if the food or beverage is energy-dense) (11). Critically, children may not compensate for the additional energy consumed from larger portion sizes at other meals (12). Thus, moderating portion sizes served to children, particularly portion sizes of energy-dense foods and beverages, is important to preventing excessive energy intake in children.

Portion sizes served to children for meals and snacks are often determined by parents or guardians (13). Children learn what and how much to consume through social modelling of their parents’ eating (14, 15). Parents also use different feeding practices to develop eating habits they deem appropriate in their children (14). Parents are therefore a primary target for moderating portion sizes served to children and fostering healthy portion size habits in children. How parents portion foods or beverages for their child (i.e. ‘parental portioning practices’) however, remains an understudied aspect of

**Plating up appropriate portion sizes for children**
parental feeding (16). Understanding how parents portion food for their children, and factors influencing this, is important to inform the design of future strategies to moderate portion sizes served to children. We therefore aimed to synthesize literature on the portioning practices of parents with children aged 2–12 years, including factors influencing these practices, using a mixed methods systematic design. Our specific research question was ‘what practices are used by parents to portion food and beverages for their child and what factors influence these practices?’

Methods

The protocol for this review is registered in PROSPERO (CRD42017067613). This review is reported in accordance with the 2009 PRISMA Statement.

Search strategy

Eligibility criteria for the included studies are presented in Box 1 according to the SPIDER framework (17), with further explanation and elaboration. Electronic databases PubMed, EMBASE, SCOPUS, PsycINFO and CINAHL Plus were searched from inception to May 2018. We compiled initial search terms using MeSH and Emtree databases, e.g. ‘portion size’, ‘meal’, ‘snack’, ‘beverage’, ‘parent’, ‘child’, ‘knowledge’, ‘perceptions’ and ‘practices’. These terms were then compared to keywords of relevant articles identified from preliminary Internet and Google Scholar scoping searches to create a comprehensive list of MeSH and Emtree terms and additional keywords to capture articles not yet indexed. Table S1 illustrates the final search strategies used. Electronic database searches were supplemented by the OpenGrey database (http://www.opengrey.eu/) and hand searching citations from existing reviews in this field that were identified from electronic database searches or review registries (PROSPERO and Cochrane). Articles retrieved from all sources were exported into Endnote X8 (Thomson Reuters, Philadelphia, United States (US)) where duplicates were removed. Remaining
articles were exported into Covidence (Veritas Health Innovation Ltd, Victoria, Australia) for systematic screening of titles and/or abstracts and full-text eligibility assessment.

[Insert Box 1 here]

Study selection

Author (LK) and research intern (AHB) independently screened all abstracts against eligibility criteria and proceeded to assess the full-text of eligible abstracts or abstracts providing insufficient information for a decision on eligibility. Disagreements were discussed and co-authors KMS and JH consulted where consensus was not achieved.

[Insert Figure 1 here]

Data extraction

One reviewer (LK) extracted data from quantitative and qualitative studies separately using a standardized data extraction form (Table S2). The results sections of qualitative articles were imported into NVivo 11 qualitative data management software (QSR International Pty Ltd., Victoria, Australia) for thematic synthesis. These data included both participant quotations and authors’ interpretations. We omitted text irrelevant to parental portioning practices e.g. parents’ views on their child’s physical activity, screen time, active play, or tooth decay prevention from three studies with research aims beyond child feeding (18-20), to ensure our qualitative data remained relevant to the research question.

Quality appraisal
Quality of included studies was assessed using the Mixed Methods Appraisal Tool (MMAT), given the applicability of assessment items to the study designs included in this review (21). Quality assessments were conducted independently by two co-authors for quantitative (LK and JH) and qualitative studies (LK and KMS), with disagreements resolved by consensus. Quality assessment criteria and overall scores were tabulated and presented graphically (Figures 2 and 3).

**Synthesis of results**

Findings from quantitative studies were summarized narratively guided by methods described by Popay et al. (22). Quantitative results on the review outcome were extracted and summarized according to explanatory measures (i.e. factors influencing parental portioning practices). Results for similar explanatory measures were compared and reported by selected sample characteristics and setting to inform generalizability. Qualitative data were synthesized thematically guided by methods described by Thomas and Harden (23). One reviewer (LK) initially coded all qualitative data line-by-line into ‘free’ codes. As each new study was coded, new free codes were developed and existing codes revised. At this stage, free codes remained close to the data. Free codes were then compared and contrasted by LK to refine, create new, and/or remove codes and structure codes into logical thematic hierarchies. Third-order author interpretations ‘themes’ were then constructed by relating thematic hierarchies back to our initial research question. We retained only those themes representing data from more than one subject. Each stage of the thematic synthesis was independently assessed by co-author KMS.

**Results**

**Study characteristics**

**Plating up appropriate portion sizes for children**
Of 385 unique records screened, 71 full-text articles were assessed against eligibility criteria and 28 included (14 quantitative, 14 qualitative; Figure 1). Tables 1A and 1B summarize the included quantitative and qualitative studies, respectively. Participating parents resided mostly in the US (quantitative 11/14; qualitative 10/14) and were predominantly female (quantitative: 100% in 3/14, 79% – 95% in 7/14, gender not reported 4/14; qualitative: 100% in 6/14, 79%–94% in 6/14, gender not reported 2/14). Almost half were conducted with specific ethnic groups and/or groups of lower income and/or education status (quantitative 5/14; qualitative 7/14). Ages of parents’ children were younger in qualitative studies (1–5 years in 9/14, 5–13 in 3/14, and 2–12 in 1/14), compared with quantitative studies (2–6 years in 5/14 studies, 5–12 in 6/14, and 3–13 in 3/14). Most quantitative studies were observational (12/14) and used questionnaires (24-29), portion size estimation or portioning tasks (30-33), a home meal portioning observation (34), or a computer-assisted interview (35). Remaining quantitative studies (2/14) were experimental in design but reported data from baseline questionnaires (36, 37). Qualitative studies used either focus groups (18-20, 38-43) or interviews (44-48), and analyzed data using content analysis methods (12/14), or grounded theory (41, 46). One study coded text for ‘portion size’ as a pre-defined theme (45). Two mapped resulting themes into domains of healthy eating, physical activity, and weight-management (41), or against two theoretical behavior change models (39).

Quality appraisal

Figures 2 and 3 illustrate the quality of quantitative and qualitative studies, respectively, according to MMAT criteria. Quantitative studies scored highly on recruiting relevant samples for their stated research question(s) and reporting sources of, and/or validity or reliability for, measurement tools used. Quality scores were however, reduced by poor reporting of response rates and/or representativeness of samples recruited.

Plating up appropriate portion sizes for children
Qualitative studies scored highly on the relevance of samples recruited and data analysis methods for answering the research question(s). Quality scores were reduced where the influence of either the researcher(s) and/or study context on findings was not reported, or potential selection bias from recruitment sources (38, 44).

[NInsert Figure 3 here]

**Narrative summary of quantitative studies**

**Parental concern about child portion sizes**

Edwards *et al.* surveyed parents (79% female) of low to middle socioeconomic status during a routine child health assessment (36). Seventy-five percent reported the portion sizes eaten by their child (aged 9–12 years) as ‘about right’, compared with 23% as ‘too much’ (36). Most (53%) of children were overweight or obese (36). Asante *et al.* surveyed parents during a routine health assessment for their child (age in years: M = 8.5, SD = 3.1) (24). Fifty-eight percent were willing to decrease family meal portion sizes, compared with eating more fruit or vegetables (87% and 85%, respectively), drinking less sugar-sweetened beverages (85%), or eating less fast food (83%) (24). More parents of children with overweight or obesity were willing to decrease family meal portion sizes than parents of children with a healthy weight (68% versus 49%, *P* = 0.001) (24). Similarly, Campbell *et al.* surveyed parents of children (age in years: M = 11.3, SD = 3.1) with obesity during a weight control clinic visit (25). Thirteen percent reported controlling portion sizes as important to family weight management, compared with physical activity (63%), eating fruit and vegetables (17%), or reducing sugar-sweetened beverages (4%) (25). Ohly *et al.* surveyed parents (94% female) of children aged 2–5 years, whom half agreed that learning about appropriate child portion sizes would be ‘very useful’ (27). More parents of low educational attainment agreed with this, compared with medium or high (59.2% versus 55.0% or 36.4%, *P* < 0.01) (27).

**Plating up appropriate portion sizes for children**
Parental estimation of appropriate portion sizes

Fulkerson *et al.* measured parents’ self-efficacy in identifying appropriate portion sizes (for their child and others). Prior to intervention, parents reported a mean (SE) self-efficacy score of 10.8 (0.26), from a possible score range of 4 – 16 (37). Robson *et al.* quantified parents’ estimates of appropriate portion sizes for their child (aged 3–10 years) using a visual portion size estimation task (31). Parents over-estimated a ‘conventional’ child portion size of baked chicken (85 grams) by a mean 42.52 (SD = 51.03) grams, while a child portion size of kernel corn (0.12 liters) was more accurate (M = −0.05, SD = 0.02) (31). Parents were mostly female (85%), with overweight or obesity (82%), and held a college degree or higher (85%) (31). Croker *et al.* quantified typical portion sizes mothers served their child (aged 8–11 years) using a practical weighing task (38). Mothers served smaller portion sizes of breakfast cereals and grated cheese, compared with chicken, pasta and peas, with substantial variation between mothers’ portion sizes, particularly for main meal items (chicken, pasta and peas) (38).

Vittrup *et al.* surveyed parents of younger children (M = 4.4, SD = 1.7), of whom 34% reported not knowing how they determine portion sizes for their child (29). Other parents gauged portion sizes by how much they thought their child would eat (19%) or used specific resources to determine portion sizes including spoons or measuring cups (14%), size of the child’s fist/palm (12%) and serving size information on food labels or existing portion size charts (10%) (29). Using a visual portion size estimation task, Potter *et al.* showed a positive correlation between the portion size a parent thought perfect for their child (aged 5–11 years) to eat for dinner and the portion size their child thought perfect for themselves (r = 0.15, P < 0.05) (30). Equally, the maximum portion size a parent thought their child would eat for dinner correlated positively with the maximum portion size their child thought they would eat for dinner (r = 0.22, P < 0.001) (30). Marx *et al.* surveyed parents (85% female) of 4–6 year old children, finding parents more frequently classified a ‘large portion’ as a meal and a ‘small portion’ as a snack (26). Dallacker *et al.* showed an association between lower numeracy scores and less accurate portion size estimation (r = −0.08, P = 0.023) among parents (86% female) (35).

Plating up appropriate portion sizes for children
Child self-serving versus parents serving

Hoffmann et al. surveyed mothers of children aged 7 – 11 years, who reported a slightly higher proportion of their children ‘often’ or ‘always’ self-serve their breakfast, lunch, dinner, and dessert on weekend days (37%, 26%, 12%, and 23%, respectively), compared with weekdays (32%, 19%, 9%, and 19%, respectively) (28). Snacks however, were reported to be self-served by children ‘often’ or ‘always’ at a similar frequency on weekend days (61%) and weekdays (62%) (28).

Relativity to parent’s portion size

Johnson et al. showed a positive association between the total energy parents served their child (aged ~4.5 years) and themselves \((r = 0.51, P < 0.0001)\), at the evening meal (34). At evening meals where parents served themselves more than they typically would, they also served more to their child \((P < 0.0001)\) (34).

Parental and child hunger

Stromberg et al. showed mothers served more energy to their child at a buffet meal when they perceived their child hungrier \((\beta = 77.95, P = 0.032)\) (33). Hungrier mothers perceived their children as hungrier \((\beta = 0.339, P = 0.02)\), and among mothers with obesity, mothers’ perception of their child's hunger mediated the relationship between a mother’s hunger and energy served to their child (33).

Anthropometric characteristics

Stromberg et al. further found that mothers served more energy to their child if the child was classified as overweight or obese, compared with a healthy weight \((\text{calories: } M = 751.19, \text{SD} = 331.2; \text{versus } M = 526.7, \text{SD} = 157.0)\) (33). Similarly, Potter et al. showed a parents’ ideal portion size for their child correlated positively with parent BMI \((r = 0.22, P < 0.001)\) and child BMI percentile \((r = 0.39, P < 0.001)\) (30). In a buffet style meal serving task where mothers served themselves and their child self-serving versus parents serving

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child a plate of food from the foods provided (e.g. pasta, meat sauce, salad), Silvia-Garcia et al. demonstrated a positive correlation between child BMI z-score and less food restriction by mothers, i.e. mothers of heavier children more often allowed their child to have foods they desired ($r = 0.14, P = 0.05$) (32). Asante et al., found equal proportions of parents of children with overweight or obesity (16%), or a healthy weight (16%), reported their child asks for second helpings at dinner (24).

**Demographic characteristics**

Silvia-Garcia et al. also found a positive association between child age in months and mothers’ allowing children to serve themselves and/or determine how much food they are served ($r = 0.15, P = 0.05$, children aged 4–5 years) (32). Mothers also restricted foods from boys more often than girls ($r = 0.16, P = 0.05$) (32). Johnson et al. showed parent of Hispanic/Latino ethnicity served less total energy to their child compared with parents of African American ethnicity ($P = 0.004$) (34). Compared with unemployed parents, employed parents served more energy to their children ($P = 0.025$), adjusting for parent ethnicity (34). Further, Johnson et al. found no differences in amounts parents served by child gender (34).

**Thematic synthesis of qualitative studies**

‘Parental portioning practices’ was framed in qualitative literature as the decision parents make on the amount (portion size) of a food or beverage to serve their child. Three themes emerged: 1) parent-related factors, 2) child-related factors, and 3) external factors, comprising multiple, inter-connected sub-themes.

**Theme 1. Parent-related factors**

**Sub-theme 1.1. Balance precedes portion size**

Parents in six studies (19, 20, 38, 44, 46, 48) identified a balanced intake of food groups as a primary...
child feeding goal ("The meal must have proteins, chicken or fish ... or from time to time meat. Yes, that’s important for me, to have proteins, so the meal is balanced, as balanced as possible." (48)). In two studies (19, 38), portion size was of lesser concern to parents than this balance at meals (‘Mothers were almost universally unconcerned about the issue of portion sizes, “It is about combinations for me, so portion size is not that much of an issue.”’ (38)). Parents’ unconcern about portion sizes was further expressed in four studies (19, 38, 39, 45), as ‘routine’ or ‘guessed’ portion sizes served to children (‘“Most parents just guess on portions”.’ (19); ‘“I don’t know. It’s just routine... ”’. (45)).

Sub-theme 1.2. Desire for a healthy child (of a healthy weight)

Parents in four studies (39, 40, 44, 46) wanted their child to be a healthy or ‘normal’ weight, as this indicated their child was healthy (‘Mothers were focused on what they perceived as healthy growth for their child. “It’s really important [to gain the right amount of weight] because that way I know whether she is healthy or not”.’ (46)). Parents of young children (aged 2–5 years) in two studies (19, 40) expressed desire for their child to be slightly overweight to prevent ill-health (‘...having a ‘chubby’ child was viewed as a positive thing by many; needing ‘a little bit of extra padding’ to cope with active play, illness and ‘growth spurts’. ’ (40)). However, parents also expressed desire to prevent too much weight gain and would restrict portion sizes if believed in the child’s best interest (‘“I just don’t want them to eat too much or gain weight then there will be a health problem to deal with”.’ (44)).

Sub-theme 1.3. Need to ensure their child is fed

Parents in five studies (19, 20, 44, 46, 48) expressed a need to ensure their child was fed as they perceived this to be their role as a parent (‘“My role...is to try and make sure that they have a well-balanced meal...as long as there’s like a vegetable, some bread, definitely milk and meat...that’s like the most important thing to have as many food groups as possible. And then to try and make sure that they eat at least enough where I feel that they’re fed. Like I’ll say, ‘Are you full now?’ And I want to make sure because that’s just my job”’. (44)). Parents in three studies (40, 44, 46) reported feeling happy to
see their child eating ‘enough’, particularly of the types of foods they wanted them eating (‘“I would feel really happy if he ate this because I would see him as eating good...Enough [of the] portions that I would want him to eat”.’ (46)). Parents in four studies (19, 20, 44, 46) served their children the types and amounts of foods they liked to ensure they ate. The notion of restricting food from a hungry child to prevent weight gain created anxiety among parents (40, 44), (‘The dilemma mothers seemed to face was their concern not to ‘give in’ [to food demanded outside mealtimes], causing their child to put on too much weight, yet...fearing that their child might genuinely need the extra nourishment...’ (40)). Parents in one study however, described limiting food outside of meal times to avoid children developing a habit of snacking (48).

**Sub-theme 1.4. Have learned the portion sizes their child will eat**

Parents in four studies (18, 20, 38, 46) stated they simply knew the portion sizes their child would eat. This understanding of their child’s ideal portion sizes developed over time with experience of their child’s eating patterns (‘Many mothers asserted that the amounts they served were based on knowing their child and knowing what the “right amount” for their child was because of their long-time experience with feeding their child.’ (46)). In deciding portion sizes to serve, this understanding was contextualized with in-the-moment factors such as time since the child last ate, prior intake that day, usual eating routine, expressions of hunger, and physical state (i.e. parents knew a tired or unwell child would eat less) (18, 20, 38, 45, 46). Parents in two studies (38, 40) interpreted their child’s ideal portion sizes as highly individual from comparison to other children or siblings’ consumed portion sizes (‘There was a widespread belief that all children are different and that the right amount for one particular child would be too much or too little for another.’ (38)).

**Sub-theme 1.5. Onus of control over portion size**

Parents in five studies (18, 19, 38, 44-46) allowed their child to self-regulate their intake at meals. In these studies, the child was also permitted autonomy to decide their own portion size (‘“I don’t decide the amount until she tells me, ‘Okay’, she doesn’t want any more”.’ (45)). Other parents interpreted their
child’s expression of satiety to mean something else (e.g. ‘wanting to do something else’) and encouraged their child to continue eating (20, 46). Alternatively, parents negotiated portion sizes with their child (18, 38, 45, 47, 48) (‘Last night when I put their food on their plates she said: oh, you haven’t given me enough. I said you can have one more piece of chicken but you’re not having anything else’.) (38).

**Sub-theme 1.6. Desire to avoid waste of time and food (money)**

Parents in three studies (19, 44, 46) wanted their child to eat what they viewed a reasonable amount of their evening meal to avoid wasting food (and therefore money), as well as their time preparing uneaten food. Further, there was evidence from one study that parents believed they would overfeed (or over-portion) a child to avoid wasting food prepared in surplus (‘So if you’ve over cooked, you will overfeed…I don’t like to throw it in the bin so it goes on the plate’.) (39).

**Sub-theme 1.7. Knowledge of portion sizes**

Parents in four studies (19, 38-40) expressed limited knowledge of appropriate portion sizes for children and themselves (‘I find it particularly difficult dishing out the correct portion size for children and for adults, I suppose. I just tend to give everybody the same amount’.) (39). Parents in three studies (19, 39, 44) referred to a child portion as smaller than an adult portion, with one specific portioning strategy being ‘cutting adult portions in half’ (19). Parents in three studies (45, 47, 48) defined a snack as ‘something small’ or a ‘small portion of food’.

**Theme 2. Child-related factors**

**Sub-theme 2.1. Age and developmental stage**

Parents in four studies (19, 38, 40, 44) described portion sizes as needing to increase as a child grows older and for developmental ‘growth spurts’ (‘she eats way smaller than the older two because she is younger. I feed her smaller amounts too because she is younger and doesn’t need as much [as] them...')
Plating up appropriate portion sizes for children
buying them in the first instance. Parents in two studies also used less healthy foods as a contingency to encourage consumption of healthier foods (‘‘So, if you want some cake, you are going to eat this!’’. (18, 46)). Indulgent feeding practices of male partners or spouses frustrated female parents in four studies (18, 39, 40, 42) who reported them to serve larger portions than they would, particularly of less healthy foods. Perceived healthier foods or beverages were offered to hungry children thought to have already eaten enough (‘‘You’re not getting thirds...Dinner is done. You can drink some water, eat a piece of fruit, that’s it’’. (44)), were permitted to be consumed by children ad libitum (‘‘If it’s healthy I’ll tend to give her more of the item, whatever it is’’. (45)), and were used to balance-out less healthy food or drink intake (‘‘So I’ll give her that [peanut butter and jelly...], but she has to eat a vegetable’’. (18)).

**Sub-theme 3.2. Portioning resources**

In two studies (19, 45), parents with younger children (aged 2–5 years) described using resources such as pre-portioned child snacks or child serving ware (e.g. ‘child-sized’ plates, bowls, and cups) to simplify, or replace entirely, their decision on the portion size to serve. Pre-packaged single portion snacks were purchased for their convenience and to restrict portion sizes of perceived less healthy foods (‘‘Um, the potato chips, I buy the small bag. So when it’s finished, that’s it’’. (45); ‘‘While on the road...a juice box is easier’’. (19)). Hand or finger sizes were viewed as convenient for deciding portion sizes without needing utensils or containers (45). Few reported using measuring cups or weighing foods to determine portion sizes (19, 45). Parents in two studies (38, 39) were unfamiliar with weighed portions and expressed unwillingness to weigh foods for their child (‘‘I hadn’t really got a clue about how much makes 30 g, or 60 g’’. (38); ‘‘I still don’t have time to figure out...I just don’t want to’’. (39)).

**Sub-theme 3.3. Authoritative guidance**

Parents in two studies (19, 20) expressed a desire for information on appropriate portion sizes for their preschool aged child and on who should decide portion sizes. Other parents (19) however, agreed
more guidance would not be welcomed due to existing ‘information overload’ (38). Yet, parents in three studies (19, 39, 40) were unaware of existing guidance on child portion sizes ('“I don’t think there is any guidance for portion sizes, I mean until you mentioned it and I felt oh actually yeah I think that’s an issue with our house”’. (39)).
Discussion

Our aim was to synthesize literature on ‘parental portioning practices’ and factors influencing these practices. ‘Parental portioning practices’ were framed in the literature as the portion size (or amount) of a food or beverage a parent serves their child and how parents’ decide these amounts. Ultimately, parents serve the portion sizes they have learned to be appropriate (or ‘enough’) for their child to be fed. These learned portion sizes differ from child-to-child, as parents view children as highly individual in the amounts of food they need. Parents aim to ensure their child eats a ‘balanced’ intake of less healthy and healthier foods and beverages. Achieving this is of greater concern to parents than portion sizes they consume. Parents are also generally content with and confident in the appropriateness of the portion sizes they serve. However, parents also need to feel their child is fed, viewing this as their role as a parent, and will serve their child the types of foods in the amounts preferred to ensure intake. Other factors influencing parental portioning include the amounts parents serve themselves, perceived child hunger, parent and child body size, and parental employment status. In reality, our findings represent ‘maternal’, rather than ‘parental’, portioning practices, due to the dominance of female subjects studied. This also signifies however, that females continue to dominate in child feeding roles.

We found that the portion sizes parents serve are those learned to be ‘enough’ for their child to be fed. This practice is consistent with how adults serve themselves at meals, with portion sizes determined by the amounts they plan to consume (49). Deciding portion sizes for a child to consume however, may be counter-intuitive to developing a child’s ability to self-regulate intake based on hunger and fullness (15, 50). We found that some parents permit children to decide their own portion sizes and others have shown that when children are permitted to do so they consume less food than if served a large portion (48).
Given parents’ limited knowledge of appropriate portion sizes for children and themselves reported in this review, education as an obesity prevention strategy may moderate portion sizes served to children. Parents’ self-efficacy in serving appropriate portion sizes can be increased by engaging parents in practical food preparation tasks that generate discussion and sharing of experiences among parents regarding portioning for their children and others (37, 51). Parents can also learn to estimate portion sizes more accurately through interactive group sessions using physical food models (52). Further, children can be trained to estimate portion sizes more accurately by making sequential comparisons between foods, measuring cups, and other portion size aids (e.g. golf ball, baseball) (53). Another strategy is to reduce children’s energy intake from a larger portion size by serving a low energy density entrée (i.e. vegetables or salad) before the main meal or reducing the energy density of a meal by incorporating more vegetables or fruit into the meal (54-58). Such strategies also increase children’s fruit and vegetable intake and may be of greatest relevance to children with obesity, who have been reported to require approximately 20% more food to feel satiated (59).

Asante et al. (24), reported that parents of children with overweight or obesity are more willing to reduce family portion sizes, compared with parents of children with a healthy weight. Why parents were more willing is unclear, although when parents perceive their child as overweight, readiness to change their child’s diet is increased. This is supported by our finding that parents adopt different portioning practices based on their perception of their child’s body size. However, as only half of parents of children with overweight or obesity consider their child overweight (60, 61), altering parental perception of what constitutes a healthy weight will be important to changing practices. For children with overweight or obesity, reducing portion sizes consumed is effective for sustained two-year weight loss when delivered as part of multi-disciplinary program comprising portion size education to children and their parents (62).

Plating up appropriate portion sizes for children
As parents also described using pre-packaged snacks targeted at children (e.g. children’s yogurts), effective front-of-package labelling on children’s products to enable parents to choose healthier pre-packaged options for their children is also warranted (63). Providing portion size guidance on such products may also support family education on healthy portion sizes for children.

We found parents to be generally unaware of existing authoritative guidance on portion sizes; an unsurprising finding given not all countries incorporate serving size guidance into food based dietary guidelines (64). Providing such guidance however, may be challenged by views parents expressed in this review regarding children being highly individual in the amounts of food they need. Thus, future guidance material for families would ideally be presented as recommended portion sizes for first serving to moderate portion size effects, while communicating the importance of allowing children to self-regulate amounts consumed. As parents view children as needing more food as they grow older, providing guidance according to child age is befitting and consistent with existing food based dietary guidelines (65-67). Guidance could also present recommended portion sizes using resources that we found some parents report using (e.g. hand or finger sizes, child-sizes plates and bowls), given their reported convenience and efficiency for deciding portion sizes.

**Future research**

For the purposes of future research, we offer a definition of ‘parental portioning practices’, based on existing literature, as the practices by which parents or guardians select the portion size (or amount) of a food or beverage to serve their child. Definitions of portion size must also be consistent. ‘Portion size’ is defined as ‘the amount of a food served or consumed in one eating occasion’ (68). For research purposes however, portion size consumed is a different outcome to portion size served. In terms of areas where future research is needed, only two studies reported actual quantities
parents serve to children (34, 38). Without such data, it is not possible to monitor changes in parental portioning or establish whether intervention is necessary to reduce portion sizes served. Other areas include 1) the extent to which children are permitted to self-serve and at what age this is initiated, 2) characteristics of families serving ‘larger-than-average’ portion sizes, and 3) whether children who are served larger portion sizes adapt to consuming larger portion sizes over time, i.e. requiring more food to reach satiety. In regards to the latter, these families would a priority group for intervention, as we found the amount of food parents serve children are intended to ensure their children are satiated (fed). Differences in parental portioning for children with a healthy weight, overweight or obesity also warrants further investigation as few studies have examined this.

**Strengths and limitations**

We included a limited scope of grey literature, although preliminary scoping searches indicated relevant literature were confined to the electronic databases we searched. We also found no evidence of studies published in languages other than English. As included studies did not report child health status, parents of children with acute or chronic illness may have been included. Our review is however, is the first to synthesize literature on parental portioning practices for children and involved comprehensive electronic search strategies across six large online databases, including grey literature sources.

**Conclusions**

In this review, we synthesized literature on ‘parental portioning practices’ and factors influencing these practices. We found parents serve the portion sizes they learn to be appropriate for their child to be fed. This differs from child-to-child, as parents view children as highly individual in the amounts of food they need. Portioning practices are primarily influenced by parents’ desire for a healthy child and balancing a child’s intake of less healthy and healthier foods and beverages. Achieving this is of greater concern to parents than portion sizes consumed. Parents are also generally content with and confident in the appropriateness of the portion sizes they serve. Other factors influencing parental
portioning include portion sizes parents serve themselves, perceived child hunger, parent and child body size, and parental employment status. Future guidance for parents on appropriate portion sizes for children should ideally be incremental with age, present recommended portion sizes for first serving to moderate portion size effects and emphasize dietary quality and allowing children to self-regulate amounts consumed. Future research is needed however, to assess the adoption and efficacy of providing such guidance to families.
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Table and Figure Legends

Box 1: SPIDER tool criteria for study eligibility (inclusion and exclusion)
Figure 1: PRISMA flow diagram of study inclusion and exclusion
Figure 2: MMAT quality appraisal criteria (quantitative studies)
Figure 3: MMAT quality appraisal criteria (qualitative studies)
Table 1A: Characteristics of included studies (quantitative studies)
Table 1B: Characteristics of included studies (qualitative studies)
### CRITERIA (SPIDER)

<table>
<thead>
<tr>
<th><strong>Sample</strong></th>
<th><strong>Inclusion</strong></th>
<th><strong>Exclusion</strong></th>
<th><strong>Explanation / Elaboration</strong></th>
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<tr>
<td></td>
<td>Parents with at least one child aged 2 – 12 years, residing in developed countries.</td>
<td>Parents of children with acute or chronic illness.</td>
<td>Residing countries were restricted to ‘very high’ Human Development Index (i.e. HDI ≥ 80), as findings will inform future public health guidance in the Republic of Ireland and Northern Ireland and parental portioning practices would likely be influenced by the broader health and economic context of a society. Children with acute or chronic illness may require medical nutrition therapy as part of their treatment and/or management that may influence the amounts of foods or beverages parents portion for their child.</td>
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<tr>
<th><strong>Phenomenon of Interest</strong></th>
<th><strong>Inclusion</strong></th>
<th><strong>Exclusion</strong></th>
<th><strong>Explanation / Elaboration</strong></th>
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<tr>
<td>Parental portioning of foods or beverages for their child.</td>
<td>n/a</td>
<td>Parental portioning refers to how parents portion foods and beverages for their child including amounts parents serve and amounts parents make available to children from which they may serve themselves.</td>
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<th><strong>Design</strong></th>
<th><strong>Inclusion</strong></th>
<th><strong>Exclusion</strong></th>
<th><strong>Explanation / Elaboration</strong></th>
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<tr>
<td>None.</td>
<td>Post-test data from experimental studies.</td>
<td>Post-test data from experimental studies aimed at modifying parental practices were excluded, as this review aimed to understand existing practices.</td>
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<th><strong>Evaluation</strong></th>
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<th><strong>Exclusion</strong></th>
<th><strong>Explanation / Elaboration</strong></th>
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<tr>
<td>Practices (and factors influencing these practices, e.g. opinions, knowledge).</td>
<td>None.</td>
<td>Factors influencing practices included a) measured indicators demonstrated to modify parents’ portioning practices and, b) factors parents themselves identified as influencing their practices. Examples included parental knowledge, attitudes or opinions on child portion size, or demographic, socioeconomic or anthropometric characteristics of the parent or child.</td>
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<tr>
<th><strong>Research type</strong></th>
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<tr>
<td>Quantitative, qualitative and mixed methods research.</td>
<td>None.</td>
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<th><strong>Other: article type</strong></th>
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<tr>
<td>Peer-reviewed original research articles and reviews.</td>
<td>Articles without or with limited results, e.g. conference abstracts, editorials or commentaries</td>
<td>Reported results were required to synthesize the evidence. In scoping searches, all relevant articles identified were published in peer-reviewed journals.</td>
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<th><strong>Other: language</strong></th>
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<tr>
<td>English</td>
<td>n/a</td>
<td>In scoping searches, we found no relevant articles published in languages other than English.</td>
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* Studies where the majority of parents had children aged 2 – 12 years were also included, e.g. children aged 1 – 5 years or 3 – 13 years.


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<table>
<thead>
<tr>
<th>Lead Author (Year)</th>
<th>Research aim(s)</th>
<th>Subjects</th>
<th>Setting</th>
<th>Subject selection (exclusion criteria)</th>
<th>Study design</th>
<th>Outcome(s)</th>
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<tbody>
<tr>
<td>Asante et al. (2009) (24)</td>
<td>To inform the design of a multidisciplinary, pediatric overweight prevention program within a primary care setting by describing (a) prevalence of overweight-related behaviors, (b) parents' perceived willingness to change these behaviors, and (c) gaps in nutrition and physical activity promotion in the practice.</td>
<td>Parents (child aged 3–13 years) = 324</td>
<td>Urban pediatric primary care clinic in Boston, US.</td>
<td>Parents attending a ‘well-child’ care visit at the clinic between July and August, 2008, were approached by research assistants to complete a questionnaire. Eligible parents could be interviewed in English or Spanish and the selected child was free of any condition restricting their diet or physical activity. Of the 330 (77%) agreeing, six were excluded as the child was ≤ 5th BMI percentile.</td>
<td>Observational, cross-sectional using quantitative methods: written questionnaire</td>
<td>Parental perceived willingness to decrease family portion sizes at meals.</td>
<td>A 58-item questionnaire using close-ended questions. Response options for questions on perceived willingness were: ‘yes, we plan to do it,’ ‘might do it,’ and ‘no, will not do it’ or ‘already doing that’. Weight and height were measured using the clinic’s scale and stadiometer by trained clinical assistants. BMI percentiles were based on 2000 CDC reference values.</td>
<td>Questions assessing perceived willingness to change based on Motivational Interviewing techniques.</td>
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<tr>
<td>Campbell et al. (2009) (25)</td>
<td>To explore parents’ (or caregivers’) awareness of and confidence in adopting recommendations for childhood and adolescent weight control.</td>
<td>Parents (child mean (SD) age 11.3 (3.1) years) = 193</td>
<td>Nemours Healthy Choices Clinic (a multidisciplinary treatment center).</td>
<td>Families attending the clinic were invited to complete a survey prior to the initiation of treatment. Surveys with more than 10% of items unanswered were excluded, although characteristics of excluded participants were comparable to those included (N = 193).</td>
<td>Observational, cross-sectional using quantitative methods: written questionnaire</td>
<td>Perceived importance of and concern about specific child and adolescent lifestyle behaviors. Confidence in ability and readiness to change the eating habits of their child or adolescent.</td>
<td>Questionnaire items included quantitative items assessing confidence in ability to change diet and physical activity behaviors of their child or adolescent and qualitative items that were coded and ranked categorically to assess the frequency at which parents identified the studied health behaviors as important components of healthy living.</td>
<td>Survey items based on motivationa l interviewin g principles. Inter-coder reliability of coded behaviors was strong (K = 0.98, P &lt; .001).</td>
</tr>
<tr>
<td>Dallacker et al. (2016) (35)</td>
<td>To examine the relationship between parental numeracy and children's BMI z-</td>
<td>Parents (child aged 6–12 years) = 320</td>
<td>Family home of the parent-child dyad.</td>
<td>Parents identifying as the nutritional gatekeepers, with one or more children aged 6–12 years, were recruited by a commercial market research</td>
<td>Observational, cross-sectional using quantitative methods:</td>
<td>Parental portion size estimation skills</td>
<td>Parents were presented with 15 images each of five typical foods for children (e.g. cornflakes), in one tablespoon portion size increments. Parents were asked: 'The recommended amount for children aged</td>
<td>Picture sets were pilot tested with parents demonstrating</td>
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<tr>
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<td>Edwards et al. (2017) (36)</td>
<td>To assess parents' reported child eating and activity behaviors and selected goals for the Fitwits intervention.</td>
<td>Parents (child aged 9–12 years) = 140</td>
<td>Country, US</td>
<td>The research team delivered training to reception and nursing staff and distributed printed pages to staff and parents outlining the study eligibility criteria (child aged 9–12 years, attending a well-child scheduled visit with a parent/guardian in attendance).</td>
<td>Experimental, pre-post using quantitative methods: written questionnaire (pre- and post-intervention), anthropometric measurements</td>
<td>Parental perceived adequacy of their child's portion sizes (pre-intervention).</td>
<td>Parental self-efficacy for identifying appropriate portion sizes (for their child and others).</td>
<td>None for this specific question.</td>
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<tr>
<td>Fulkerson et al. (2018) (37)</td>
<td>To describe family home food environment and nutrition-related parent and child outcomes of a family meals childhood obesity prevention program.</td>
<td>Primary meal-preparing parents (child aged 8 – 12 years) = 160</td>
<td>Country, US</td>
<td>The child behavior survey was developed based on questions used in existing published tools. In this survey, parents were asked to respond to the question 'my child eats a portion size of food at each meal that is... 'too little', 'about right' or 'too much'.'</td>
<td>Experimental, pre-post using quantitative methods: written questionnaire (pre- and post-intervention), anthropometric measurements</td>
<td>Self-efficacy assessed by four items e.g. 'I am confident that I know appropriate portion sizes for my child’s meal', and 'I am confident that I can estimate recommended serving sizes for many foods'. Possible scores across the four items ranged from 4 to 16.</td>
<td>Internal consistency of self-efficacy scale (4-items) was α = .84.</td>
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<tr>
<td>Hoffmann et al. (2018) (28)</td>
<td>To examine differences in children’s intake</td>
<td>Mothers (child aged 7 – 12 years)</td>
<td>Country, US</td>
<td>Observational, cross-sectional using Maternal reported frequency of mothers were asked whether their child helps themselves to food on their own for</td>
<td>Maternal reported frequency of help themselves for food on their own.</td>
<td>None for this specific question.</td>
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<tr>
<td>Johnson et al. (2014) (34)</td>
<td>To assess whether the amounts parents serve to children at meals are related to the amounts they serve themselves.</td>
<td>Parents (child aged ~4.5 years (mean 53.2 ± 8.3 months) = 145</td>
<td>Country, US Race/ethnicity/culture/language, Hispanic/Latino: 56.6%, African American: 39.3% Socioeconomic status, high school or less: 52.4%, employed: 53.1% Marital status, married: 39.3%</td>
<td>Participant's family home. Parents were recruited from 33 Head Start centers in three districts of Houston, Texas during child pick-up / drop-off times and Head Start parent meetings. Interested parents (n = 275) were informed on the study procedures, of which 145 parents (~6%) consented for themselves and their children to participate out of an initial ~2500 eligible families from the Head Start centers.</td>
<td>Observational, cross-sectional using quantitative methods: written questionnaire, home meal portioning observation, anthropometric measurements</td>
<td>Amounts of food parent served to their child(ren) and amounts served to themselves. For the home meal observation, all food placed onto the children's dinner plates by the parent was measured using a standardized digital photography method. Second helpings were noted and estimated. Food plate waste was measured on a digital scale to the nearest 0.1g. Child weight and height was measured twice by trained staff using a standard protocol to the nearest 0.1kg and 0.1cm, respectively, and the average taken. Child BMI was based on 2000 CDC reference values.</td>
<td>Digital photography method previously validated with proven reliability.</td>
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<td>Marx et al. (2016) (26)</td>
<td>To examine preschoolers' and their parents' characterizations of eating episodes based on cues (i.e. time, portions size, preparation, content and emotion) used for defining these occasions as a meal or a snack.</td>
<td>Parents (child aged 4–6 years) = 26</td>
<td>Country, US Gender, Female: 85% Age, mean (SD) years: 35.1 (6.6) Race/ethnicity/culture/language, Caucasian 92%</td>
<td>Participant completed questionnaire online. Invitation letters were distributed to parents via participating day care centers (n = 6) in Northwest Ohio. Eligible children were aged 4–6 years and familiar with the terminology (i.e. 'I'm going to eat a meal' and 'It's time for a snack').</td>
<td>Observational, cross-sectional using quantitative methods: online questionnaire</td>
<td>Parental classification of portion-related cues as a meal or snack. Parents were asked to classify four portion-related cues (a large portion, a small portion, everything is served and as much as someone wants) as a 'meal', 'snack', 'either (i.e. meal or snack)' or 'neither'.</td>
<td>None reported.</td>
<td></td>
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<tr>
<td>Ohly et al. (2013) (27)</td>
<td>To explore factors influencing parents’ food choices for their children and their views on support for healthy eating.</td>
<td>Parents (child aged 2–5 years) = 261</td>
<td>Country, England Gender, Female 94.2% Age, mean (SD) years: 33.5 (6.6) Race/ethnicity/culture/language, White British 75.3% Socioeconomic status, employed:</td>
<td>Researchers visited child and parent play sessions at children's centers and invited parents with a child aged 2–5 years to complete the questionnaire. Staff members were given additional copies of Questionnaire re items developed based on validated items.</td>
<td>Observational, cross-sectional using quantitative methods: written questionnaire</td>
<td>Parental perceived usefulness of support for learning about appropriate Portion sizes for children. Parents were asked 'which of the following would you find useful at your children's center?' with response options 'very useful', 'moderately useful' or 'not useful'. One item was 'learning about appropriate portion sizes for children'.</td>
<td>None reported.</td>
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<th>Lead Author (Year)</th>
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<tr>
<td>Potter et al. (2017) (30)</td>
<td>To explore the extent to which a child's BMI is predicted by their parent's beliefs about the child's ideal and maximum portion size and/or by the child's own beliefs.</td>
<td>Parents (child aged 5–11 years) = 198</td>
<td>Country, England Socioeconomic status, employed: 74% (parents with BMI &lt; 25kg/m²) or 84% (parents with BMI ≥ 25 kg/m²). Marital status, married/living with partner: 76% (parents with BMI &lt; 25kg/m²) to 79% (parents with BMI ≥ 25 kg/m²). Weight status, overweight or obese: 59.5%. Child weight status, &lt; 85th percentile: 52.1%</td>
<td>Parents were assessed at their home (or a testing booth for those recruited at the science center). Parents were recruited from an existing randomized trial (n = 69) and an opportunity sample from a local interactive science center in Bristol (n = 148). Eligible parents had an English-speaking child aged 5–11 years, free of food allergies or intolerances and not following a vegetarian or vegan diet. Of the 217 recruited parents, 19 were excluded due to learning disability, child with a vegetarian or vegan parent, and missing date of birth.</td>
<td>Observational, cross-sectional using quantitative methods: written questionnaire, anthropometric measurements, and visual portion size estimation task</td>
<td>Parents' ideal and maximum tolerated estimated portion sizes for their child</td>
<td>Visual portion size estimation task: Parents were shown an image of a main meal and asked to estimate the portion size in response to the question: ‘Imagine your child is going to eat this food for dinner and no other food is available. What would be your child’s perfect amount for dinner?’ and then again in response to: ‘Imagine your child is going to eat this food for dinner and no other food is available. What would be your child’s perfect amount for dinner?’</td>
<td>Yes. Visual portion size estimation task based on previously validated method.</td>
</tr>
<tr>
<td>Robson et al. (2016) (31)</td>
<td>To understand barriers and facilitators to families eating convenience foods (authors also collected data on parents’ perceptions of portions to characterize the sample).</td>
<td>Parents (child aged 3–10 years) = 27</td>
<td>Country: US Gender, Female: 85.2% Age, mean (SD) 37.6 (6.5) years Race/ethnicity/culture/language, American Indian/Alaskan Native 3.7%, Asian 3.7%, Black or African American 29.6%, White 63.0% Socioeconomic status, college degree or higher 85.1%, full-time employment: 74.1%; mean (SD) hours worked per week: 39.4 (8.4), annual income ≥ $100,000: 53.6%</td>
<td>Pediatric medical center (unclear precisely where data were collected). Study flyer emailed to ~15,000 employees of a large pediatric medical center. Of the 72 individuals who responded to the study flyer (~5%), 51 individuals were screened, 48 met eligibility criteria (two unable to attend focus group times, one ate dinner out &lt;3 times/week). A further 21 subsequently did not attend the focus groups.</td>
<td>Observational, cross-sectional using mixed-methods: written questionnaire, anthropometric measurements, visual portion size estimation task</td>
<td>Parents' estimate of a child-size portion</td>
<td>Visual portion size estimation task: parents given eight images of different portion size for baked chicken (28.35 g, 56.70 g, 85.05 g, 113.40 g, 141.75 g, 170.10 g, 226.80 g, or 340.19 g) and for kernel corn (4.92 mL, 14.79 mL, 0.06 L, 0.09 L, 0.12L, 0.16 L, 0.18 L or 0.24 L) and asked to identify which best represented a child-sized portion. Parent estimates were subtracted from the standard portion sizes of these foods for a meal to yield a portion size accuracy score.</td>
<td>Not reported (for portion size estimation task).</td>
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<tr>
<td>Stromberg et al. (2016) (33)</td>
<td>To examine factors that may influence the portion sizes a mother serves her child at a mealtime.</td>
<td>Mothers (child aged 3–6 years) = 29.</td>
<td>Country, US</td>
<td>Laboratory setting.</td>
<td>Observational, cross-sectional using quantitative methods: written questionnaire, anthropometric measurements, and maternal food and beverage portioning activity.</td>
<td>Calorific mother served to child.</td>
</tr>
</tbody>
</table>

Marital status, married: 70.4%
Weight status, mean (SD) BMI 33.5 (9.1) kg/m², overweight or obese: 81.5%

Parents were recruited from Head Start centers (numbers not reported) in a large urban city in southeast United States. Participating mothers were participants of a larger study examining child self-regulation. If parents had more than one child aged 4–5 years, one of these children was selected at random.

Observational, cross-sectional using quantitative methods: written questionnaire, anthropometric measurements and buffet meal serving task.

Laboratory setting.

Parents recruited via pediatric offices, preschools, day care centers, and local media. Twenty nine of the 30 mother–child dyads that were initially eligible at phone screen (i.e. both mother and child were free of medical conditions requiring special dietary restrictions) and arrived for their appointment were included in the sample. One mother-child dyad was excluded as a result of eating within 2 h prior to the session.

Observational, cross-sectional using quantitative methods: written questionnaire, anthropometric measurements, and maternal food and beverage portioning activity.

Laboratory setting.

Portioning activity: Mothers asked to prepare a lunch/dinner plate for themselves and their child from the foods and beverages available (baby carrots, cheese slices, apple slices, crackers, biscuits/oatmeal, macaroni and cheese, vegetable lasagna, chicken nuggets, water, 1% milk and apple juice). Children also allowed to ask their mother to serve desired food items. During the meal, mother and child were observed by trained coders who recorded amounts of foods served and consumed using an established protocol. Left overs were subtracted from amounts consumed. Perception of hunger: Mothers responded to two items in the written questionnaire: (1) mother asked to rate her own hunger at present, (2) mother asked to rate her child’s hunger at present. Child and mother height and weight were measured using a digital scale to the nearest 0.1 kg and a stadiometer to the nearest 0.1 cm, respectively.

Percentage agreement between the two coders of the videotapes ranged from 63% to 100% (based on a sample of 34/186 video recordings).
<table>
<thead>
<tr>
<th>Lead Author (Year)</th>
<th>Research aim(s)</th>
<th>Subjects</th>
<th>Setting</th>
<th>Subject selection (exclusion criteria)</th>
<th>Study design</th>
<th>Outcome(s)</th>
<th>Measurement</th>
<th>Validity / Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vittrup et al. (2018) (29)</td>
<td>To investigate the eating and exercise habits of families with young children.</td>
<td>Parents and caregiver s (child aged 3 – 10 years) = 205</td>
<td>Country, US Gender, Mothers: 87% Age, mean (SD) years: 32.7 (8.5) Race/ethnicity/culture/language, Hispanic: 49%, White: 8%, Black 8%, Not reported 35% Socioeconomic status, some college or higher 57%, annual income of &lt; $40,000: 80% Marital status, Married: 54% Weight status, overweight or obese: 69% Child gender, Female: 53% Child age, mean (SD) years: 4.4 (1.7) Child weight status, overweight or obese: 40%</td>
<td>Parents completed questionnaire either online or in paper-based written format.</td>
<td>Observational, cross-sectional using quantitative methods: online or written questionnaire</td>
<td>Parental method of determination of portion sizes for children.</td>
<td>Parents were asked the question ‘How do you determine portion sizes for your child?’ as an open-response question, with responses categorized quantitatively.</td>
<td>Some questions based on previous survey on childhood obesity (unclear which).</td>
</tr>
</tbody>
</table>

Abbreviations: BMI, Body Mass Index; CDC, Centers for Disease Control and prevention; SD, Standard Deviation; UK, United Kingdom; US, United States.
Data were coded using hybrid deductive and inductive content analysis approach. Coding was conducted by two authors with 95% inter-coder agreement on the first 20 interview transcripts. Codes were reduced to main themes. Observational, cross-sectional using ethnics as the setting. Parents were sourced from a larger study (n=120) examining parents’ feeding practices with two child siblings. Parents were interviewed in their homes in Minneapolis or St Paul, Minnesota. Parents were sourced from a larger study (n=88) had at least one child sibling aged 2–18 years who lived with the sibling and had the same parent/primary caregiver. Interview transcripts were coded for the theme ‘portion size’ by one research assistant and sub-themes identified and defined through peer discussion. Portion size sub-themes were then compared across parental race/ ethnicity, education, and household food security using qualitative methods: Face-to-face interviews. An expert in qualitative interviewing skills. Data analysis: Interviewers were research staff of comparable ethnicities as the study sample, trained using standardized protocols, and required to reach certification level in qualitative interviewing skills.

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<tr>
<td>Berge et al. (2016) (44)</td>
<td>To describe parent feeding practices with siblings.</td>
<td>Parents (child aged 2–12 years) = 88</td>
<td>Country, US Gender, Female: 94% Age, mean (SD) years: 34 (7) Race/ethnicity/culture/language, African American: 64% Socioeconomic status, employed: 49%, annual household income &lt;$35,000: 77% Weight status, overweight or obese: 82% Child weight status, ≥ 85 percentile: target child 52%, sibling 42% Child age, mean (SD) years: target child 9 (2), sibling 9 (4) Child gender, Female: target child 47%, sibling 56%</td>
<td>Parents were interviewed in their homes in Minneapolis or St Paul, Minnesota.</td>
<td>Parents were sourced from a larger study (n=120) examining parents’ feeding practices with two child siblings in the same household. Eligible, consenting parents (n=88) had at least one child sibling aged 2–18 years who lived with the sibling and had the same parent/primary caregiver.</td>
<td>Observational, cross-sectional using qualitative methods: Face-to-face interviews</td>
<td>Interviewers were research staff of comparable ethnicities as the study sample, trained using standardized protocols, and required to reach certification level in qualitative interviewing skills.</td>
</tr>
<tr>
<td>Blake et al. (2015) (45)</td>
<td>To examine parents’ conceptualizations of portion size and the strategies they use to portion snacks in the context of preschool aged children’s snacking.</td>
<td>Parents (child aged 3–5 years) = 60</td>
<td>Country, US Gender, Female: 93% Race/ethnicity/culture/language, White: 28%, African American: 38%, Hispanic: 33% Socioeconomic status, some college or higher: 53%, employed 41%, WIC participation 70%, Food Stamps/SNAP/EBT participation: 80%, free/reduced school meals: 47%, Head Start program: 35%, experienced food insecurity in prior 12 months: 43% Marital status, married/living with partner: 38% Weight status, overweight or obese: 53%</td>
<td>Specific interview site not disclosed, although parents resided in Philadelphia and Boston.</td>
<td>Participants were recruited using flyers posted in WIC offices and online community listings such as Craigslist. Inclusion criteria were parents aged 18 years or older primarily responsible for feeding child, low-income household, and child free of severe food allergy(ies), chronic medical condition or developmental disorder that influenced feeding.</td>
<td>Observational, cross-sectional using qualitative methods: Semi-structured interviews</td>
<td>Five research assistants including one bilingual assistant (English-Spanish) conducted the interviews. An expert in qualitative methods trained the interviewers to conduct the qualitative in-depth interviews during a two-day workshop.</td>
</tr>
<tr>
<td>Croker et al. (2009) (38)</td>
<td>To investigate parents' attitudes, knowledge, practices and concerns about appropriate portions for children.</td>
<td>Mothers (child aged 8–11 years) = 14</td>
<td>Country, England Race/ethnicity/culture/language: white British: 86%, black British: 7%, Asian: 7% Socioeconomic status, bachelor degree or higher: 36% Child gender, Female: 64%</td>
<td>Parents of children in participating schools in London, England. Specific site of focus groups not disclosed.</td>
<td>Parents (N = 398 / 786) recruited via schools agreed to take part in a prior study on the impact of feedback to parents on their child’s weight. Of those volunteering for further research (n = 160), 30 were randomly selected and invited to participate in focus groups for this research, of which 14 agreed.</td>
<td>Observational, cross-sectional using mixed-methods: quantitative weighing task and qualitative focus groups</td>
<td>Each focus group was conducted by the same two trained researchers. Details of their characteristics not provided.</td>
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**Plating up appropriate portion sizes for children**
Details of their transcripts were analyzed by two observational, characteristics not researchers independently. Text was coded for basic interpretation and then mapped against the capability opportunity motivation behavior model and a theoretical domains framework based on key theoretical constructs relevant for behavior change.

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<tr>
<td>Curtis et al. (2017) (39)</td>
<td>To explore parents' capability, opportunity, and motivation towards portion control behaviors with their children.</td>
<td>Parents (child aged 5–11 years) = 22</td>
<td>Country, England Gender, Female: 82% Child weight status, (parents recruited from childhood weight management programs) overweight (6/15), 'very overweight' (8/15).</td>
<td>Parent focus groups conducted at the university and community settings.</td>
<td>Observational, cross-sectional using qualitative methods: qualitative focus groups</td>
<td>Details of their characteristics not provided.</td>
<td>Transcripts were analyzed by two researchers independently. Text was coded for basic interpretation and then mapped against the capability opportunity motivation behavior model and a theoretical domains framework based on key theoretical constructs relevant for behavior change.</td>
</tr>
<tr>
<td>Douglas et al. (2014) (40)</td>
<td>To explore mothers' perspectives about the nature and causes of childhood obesity, their views and experiences of managing their child’s weight, and about effective weight management strategies.</td>
<td>Mothers (child aged 3–4 years) = 34</td>
<td>Country, Scotland Age, years range 23–42 (median 37) Socioeconomic status, various occupations (manual, professional, self-employed and full-time carer) Child weight status, 2/34 mother believed their child had a weight problem</td>
<td>Focus groups conducted in eight various community-based locations throughout North-East Scotland.</td>
<td>Observational, cross-sectional using qualitative methods: qualitative focus groups</td>
<td>Details of their characteristics not provided.</td>
<td>Interview transcripts were read and re-read independently by two researchers to draft and then negotiate a coding framework. Throughout coding new themes were integrated by constant comparison to the framework, and disconfirming, dominant or marginalized data considered.</td>
</tr>
<tr>
<td>Flores et al. (2012) (41)</td>
<td>To identify parents' perspectives on healthy eating, physical activity, and weight-management strategies for overweight Latino children.</td>
<td>Parents (child aged 6–17 years; median 9) = 19</td>
<td>Country, US Age, years range 26–61 (median 35) Race/ethnicity/culture/language, undocumented immigrant: 26% Socioeconomic status, graduated high school: 79%, annual family income ≤ $25,000: 42% Marital status, married and living with spouse: 84% Child age, years range 6–17 (median 9) Child weight status, ≥ 85 percentile 40%, ≥ 95 percentile 60%</td>
<td>Milwaukee, Wisconsin. Specific site of focus groups not disclosed.</td>
<td>Observational, cross-sectional using qualitative methods: qualitative focus groups</td>
<td>Details of their characteristics not provided.</td>
<td>Transcripts were coded thematically, independently by reviewers and differences resolved by consensus. Common themes across groups were then identified by three observers to create a taxonomy of themes highlighting similarities and differences across groups and specific study domains of: healthy eating, physical activity, and weight-management strategies.</td>
</tr>
<tr>
<td>Herman et al. (2012) (18)</td>
<td>To understand the contextual factors that might influence how</td>
<td>Mothers (child aged 36–66)</td>
<td>Country, US Age, mean years 27.5 (range 20–41) Race/ethnicity/culture/language, Black: 91%</td>
<td>Focus groups conducted at Temple University,</td>
<td>Observational, cross-sectional using qualitative</td>
<td>Lead researcher of focus groups had background in sociology and</td>
<td>Transcriptions were analyzed inductively using the constant comparison method. Three researchers independently read the</td>
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<tr>
<td>Jacquier et al. (2017)</td>
<td>To examine caregiver attitudes and perceptions towards provision of foods and beverages in-between meals and what constitutes a snack or snacking occasion.</td>
<td>Caregivers (child aged 1–5 years) = 19 (18 parents, 1 child-minder)</td>
<td>Switzerland</td>
<td>Caregivers recruited from a database of national landline telephone numbers (screened over the phone). Eligible caregivers were primarily responsible for feeding their child aged 1–5 years, were aged 18 years or older, were not employed in nutrition or had recently taken part in a child-feeding study and resided in the French speaking region of Switzerland.</td>
<td>Observational, cross-sectional using qualitative methods: in-depth interviews</td>
<td>Details of their characteristics not provided.</td>
<td>Interview transcripts were analyzed by inductive thematic analysis using AtlasTi software. Initial open coding of text was cross-checked against the “Food Choice Process Model” theoretical framework for similarities/differences. Coding as led by one author with two co-authors overseeing each phase of the analysis.</td>
</tr>
<tr>
<td>Johnson et al. (2015)</td>
<td>To identify the underlying influences on mothers’ behaviors when preparing a plate for their child, how their motivations and goals for child consumption related to the amounts they served, and their conceptions of how much is appropriate to serve their child.</td>
<td>Mothers (child aged 2–5 years) = 30 (included 2 grandmothers)</td>
<td>US</td>
<td>Mothers were recruited via Head Start centers in Denver/Aurora, Colorado via flyers placed in center lobbies, referral by center teachers, and direct approach by research staff during morning and afternoon drop-off and pick-up times at the centers.</td>
<td>Observational, cross-sectional using qualitative methods: qualitative semi-structured interviews</td>
<td>Researchers were experienced in qualitative research with backgrounds in nutrition, child development and parenting related to child feeding, and in social psychology as it relates to parenting and childhood obesity development in low income families.</td>
<td>Interview transcripts were analyzed using grounded theory. A qualitative expert and the interviewer created an initial code manual using a constant comparative method. Two coders then used the coding manual to independently code each transcript, one or two at a time, and met together to compare coding. Each coded transcript was then imported into NVivo software to examine codes for patterns and relationships among to identify higher order themes that were then discussed for meaning to form final conclusions regarding the themes.</td>
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<tbody>
<tr>
<td>Lora et al. (2017) (42)</td>
<td>To examine the views of Hispanic mothers regarding fathers’ roles in promoting healthy behaviors at home.</td>
<td>Mothers (child aged 2–5 years) = 55</td>
<td>Country, US Age, mean (SD) years: 34.6 (8.0) Race/ethnicity/culture/language, place of birth Mexico: 85%, Central or South America: 11%, United States: 4%, speaks only Spanish or Spanish better than English: 89% Socioeconomic status, high school education or less: 92%, unemployed: 78%, SNAP participant: 53%</td>
<td>Focus groups conducted at the local Latino Community Development Agency in Oklahoma City.</td>
<td>Participants were recruited from churches, community agencies, preschools and day care centers, with the assistance of a community health worker, in southwest Oklahoma City. Eligible mothers identified as Hispanic, lived with target child and child's father, and were a low-income family.</td>
<td>Observational, cross-sectional using qualitative methods: qualitative focus groups</td>
<td>Details of their characteristics not provided, although principle investigator had prior experience with Hispanic families from different countries in community-based programs.</td>
</tr>
<tr>
<td>Martin-Biggers et al. (2015) (19)</td>
<td>To examine preschool parents’ cognitions, barriers, supports and modelling of key obesogenic behaviors (including portion sizes).</td>
<td>Parents (child aged 2–5 years) = 139</td>
<td>Country, US Age, mean (SD) years: 32.18 (7.12) Race/ethnicity/culture/language, first language: Spanish: 40% Socioeconomic status, high school or less: 34%, food insecurity in the last year: 27%</td>
<td>New Jersey and Arizona chosen due to higher preschool childhood obesity rates at the time of study. Specific site of focus groups not disclosed.</td>
<td>Participants whose primary language was English or Spanish were recruited via flyers posted at community sites and emails sent from workplace directories in New Jersey and Arizona.</td>
<td>Observational, cross-sectional using qualitative methods: qualitative focus groups</td>
<td>Details of their characteristics not provided, although researchers were fluent in the language used to conduct the focus groups (i.e. English or Spanish)</td>
</tr>
<tr>
<td>Roth-Yousey et al. (2012) (43)</td>
<td>To understand parent beverage expectations for early adolescents by eating occasion at home and in various settings.</td>
<td>Parents (child aged 10–13 years) = 49</td>
<td>Country, US Gender, Female: 86% Age, 18–40 years: 59% (range 18–51+) Race/ethnicity/culture/language, White: 49%, Hispanic or Latino: 33% Socioeconomic status, high school/GED or less: 33%, employed: 55%, participant of food assistance program: 53%</td>
<td>Specific site of focus groups not disclosed.</td>
<td>Participants who were a parent or caregiver of a child aged 10–13 years, were recruited using fliers posted in middle schools and community centers in low-income neighborhoods within a large Midwestern metropolitan area.</td>
<td>Observational, cross-sectional using qualitative methods: qualitative focus groups</td>
<td>Details of their characteristics not provided, although those conducting focus groups were bilingual (as groups were conducted in English and Spanish)</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Lead Author (Year)</th>
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<tr>
<td>Sherry et al. (2004) (20)</td>
<td>To explore maternal attitudes, concerns, and practices related to child feeding and perceptions about child weight.</td>
<td>Mothers (child aged 2–5 years) = 101</td>
<td>Country, US</td>
<td>Focus groups held in conference rooms of health department clinics and in classrooms of Pennsylvania State University campus.</td>
<td>Observational, cross-sectional using qualitative methods: qualitative focus groups</td>
<td>Focus group discussions were led by an anthropologist fluent in English and Spanish, and experienced in focus-group work among whites, African Americans, and Hispanics.</td>
<td>Transcripts were coded by two authors and typed themes into a master table for comparisons within racial/ethnic and income categories. Key findings were defined as themes that arose in all three groups within a racial/ethnic or income category or across the majority of all groups. All co-authors met several times to review findings and reach consensus on the major group themes.</td>
</tr>
<tr>
<td>Younginer et al. (2016) (47)</td>
<td>To examine definitions of snacks among a diverse sample of low-income urban caregivers of preschool-aged children.</td>
<td>Parents (child aged 3–5 years) = 59</td>
<td>Country, US</td>
<td>Interviews conducted in a research setting.</td>
<td>Observational, cross-sectional using qualitative methods: qualitative semi-structured interviews</td>
<td>Details of their characteristics not provided. A bilingual research assistant conducted interviews in Spanish.</td>
<td>Transcripts were coded by two trained researchers. Transcript passages were organized by interview question, 50% of transcripts were then open-coded by one coder to identify themes, open-coding was checked by the second coder for agreement, the primary coder then open-coded the remaining 50% of transcripts. Axial coding was conducted to identify relationships between open codes and selective coding was used to identify themes related to the research question. Coders verified coding at monthly meetings until all transcripts had been coded and organized into dimensions.</td>
</tr>
</tbody>
</table>

Abbreviations: BMI, Body Mass Index; EBT, Electronic Benefits Transfer program; GCSE, General Certificate of Secondary Education; GED, General Equivalency Diploma (high-school level); SD, Standard Deviation; SNAP, Supplemental Nutrition Assistance Program; UK, United Kingdom; US, United States; USD, United States Dollar.

Plating up appropriate portion sizes for children