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ORIGINAL ARTICLE

School lunch portion sizes provided for children attending early years settings within primary schools: A cross-sectional study

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Abstract

Background: In England, many children attend an early years' setting (EYS) that is part of a primary school. Where a school lunch is available, this is often the same for both EYS and school children. This study explored how school lunch portion sizes served for 3–4-year-old EYS children compared with portion size guidance for EYS and schools, given that recommendations are different for EYS and school-aged children.

Methods: Twelve schools were recruited in four local authorities, each of which provided a school lunch to children attending EYS (aged 3–4 years) and reception classes (aged 4–5 years) from the same menu. Two portions of each menu item were weighed, each day, for five consecutive days. Mean, median, standard deviation and correlation coefficient were calculated for each food item.

Results: Most caterers reported serving the same-sized portions to both 3–4-year-olds and 5–7-year-olds. Food items falling outside of the typical range for EYS were more commonly above the range (10 food items) than below it (6 food items). Notably, portions of cakes and biscuits were larger than recommended. Portion weights falling outside of the recommended range for 4–10-year-olds were usually too small (12 of 14 items). Some foods provided by the schools in the study did not have typical portion sizes for EYS as they were not 'good choices of foods to serve'.

Conclusions: These results suggest caterers may not be following guidelines appropriate for all the children they are catering for.

KEYWORDS

children, early years, portion size, portion weight, school lunch

Key highlights

- Caterers reported serving the same-sized portions to 3–4-year-olds and 4–7-year olds in 9 of 10 schools.
- Portion sizes as served to 3–4-year-olds were more likely to be too large, whilst also being below the recommended range for 4–7-year-olds. Meeting the needs of children with different requirements may be challenging for caterers.
- Some foods commonly provided (chips, meat products and cakes/biscuits/flapjacks [without fruit]) did not have typical portion sizes for early years' settings (EYS) listed as part of the voluntary food and drink guidelines. This may make appropriate sizing of portions a challenge for caterers.

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- Where partial portions (two or more foods from the same group, counted as ‘one portion’) were provided, the total portion of a food group was often larger than recommended.
- Foods representing good sources of micronutrients (baked beans when served as a vegetable, fish within a main meal, egg, soft cheese and custard) were particularly low in comparison to typical portion sizes for EYS, with at least 90% of portions of each falling below the typical range.

INTRODUCTION

Most children aged 3 and 4 years in England (92% and 94%, respectively) access funded early years' education.¹ Early years' settings (EYS) include child minders and nurseries, with 20% of childcare places provided at preschools within infant or primary schools.¹ Early education supports positive outcomes by offering children a space to learn, develop new skills, make new friends and have fun as well as supporting their transition to school.² Early intervention has been identified as key to reducing health inequalities and improving educational achievement in later life.^{3–5}

Children grow and develop quickly during their early years (0–5 years), and adequate nutrition is essential for young children's health.^{6–9} In the United Kingdom, however, many children have poor intakes of essential nutrients. Intakes of iron, zinc, vitamin A and vitamin D are lower than recommended among some groups, particularly those from families with a lower income or an ethnic minority background.^{10–12} Meanwhile, consumption of free sugars and salt is higher than recommended.^{10–12} Surveys of preschool children in the United Kingdom also revealed intakes of protein that are higher than the UK reference nutrient intake,¹² which may be associated with a higher body mass index in later childhood.¹³ Food provided within EYS should, therefore, aim to optimise nutritional intake as well as positively influence the development of life-long healthy eating habits among all children who attend.^{14–18}

Unlike schools, there are no mandatory national standards in place for the food provided within EYS in England¹⁹ other than the requirement for food provided to be ‘healthy, balanced, and nutritious’.² Government-commissioned voluntary food and drink guidelines for EYS in England were originally produced by the Children's Food Trust (a charity and former non-departmental government body which closed in 2017) in 2012, with an updated version published by the charity Action for Children in 2017.^{20,21} Example menus for EYS were also published in 2017 by Public Health England and illustrate how the guidelines can be met in practice.²² Implementation of these guidelines has not been formally monitored, and it is not known how widely these are used in EYS. The voluntary guidelines include food groups to be provided (‘potatoes, bread, rice, pasta and other starchy carbohydrates’; ‘fruit and vegetables’;

‘beans, pulses, fish, eggs, meat and other proteins’; and ‘dairy and alternatives’); tips for reducing fat, salt and sugar; guidance for provision of drinks; products to avoid; and typical portion sizes for good choices of food to serve.²¹

Portion sizes are one area of the guidance which could make a substantive difference to the intake of energy and nutrients in preschool children. Previous studies have shown that staff serving school meals do not judge portion sizes accurately²³ and that larger portion sizes lead to greater energy intake without compensatory behaviours at subsequent mealtimes.^{24–27} One of the studies manipulating portion sizes among preschool children found a more pronounced effect on children with a higher-weight status or lower ratings for satiety responsiveness, who had greater increases in energy intake from larger portion sizes. This effect was also sustained when portion sizes remained high over several days.^{28,29}

Observational studies which have explored the menus and food provided within EYS are few and have usually focused on nursery settings, but of the previous studies identified,^{30–33} only two considered portion size.³² In the study published by Parker et al., a full menu cycle was collected along with recipe information and number of servings per recipe. Menus were analysed against Caroline Walker Trust guidelines,³⁴ but portion size data were not reported.³² In the study published by Nicholas et al., portion size data were reported but combined for all types of EYS and were collected for children aged 1–4 years rather than for those aged 3–4 years specifically. Lunchtime portion size data are available from surveys completed in both primary and secondary schools.^{35,36} Portion sizes were more likely to be within the recommended range in primary schools, compared with secondary schools (48% in primary schools compared with 18% in secondary schools), but the interquartile range of many foods in both settings was high.³⁵ Foods in secondary schools were more likely to have a lower-than-recommended portion size, whereas those in primary schools were equally likely to be higher or lower than the range recommended.³⁵

Research on food provision within EYS has often focused on nursery settings. Meanwhile, evaluation of provision within schools has not typically included the food provided to preschool children.^{20,21} Given the proportion of 3–4-year-old children attending

state-funded school settings and that these EYS often share the same food provider and menu with infant or primary school-aged children, this study aimed to explore the portion sizes served within school-based EYS. Portion sizes were compared with typical portion sizes included as part of the voluntary food and drink guidelines for EYS in England to determine whether they were within a typical range for 3–4-year-old children.

METHODS

School recruitment

Infant and primary schools in Sheffield with nursery provision were identified using the government's school database.³⁷ In January 2022, all 78 schools identified were contacted by letter inviting them to participate. Two schools agreed to participate after receiving the letter, and the remaining schools were contacted by telephone during February and March 2022. Schools were eligible to participate only if school lunches were available to children attending the school nursery. To help ensure adequate variety in lunch provision, a maximum of two schools using the same catering provider were recruited to participate, and purposive sampling of further schools in three other local authority areas was used to ensure this variety. Twelve schools were initially recruited to participate, but two schools later withdrew before data collection, giving a final total of 10 schools located in 4 local authorities (local authorities are geographical areas situated within England). Catering in schools in England is typically provided directly by the school, by the local authority (city or area council) catering department or by a private caterer, contracted by either the school or the local authority. Lunches in four schools were provided by the school, in four schools by one of three private catering companies and in the remaining two schools by local authority caterers. Ethical approval was granted by Sheffield Hallam University (ID: ER38429936).

Collection and weighing of school lunches

Data collection in each school was conducted over five consecutive school days. Schools were visited between February and July 2022 at a time convenient to each school. A copy of the school lunch menu and recipes used during the week of data collection was provided by each school (or its caterer if appropriate), and the researcher checked which lunch options were available for children within the nursery. On each day of data collection, school kitchen staff were asked to provide two portions of each main meal (including any starchy and/or vegetable accompaniments), two portions of each vegetarian meal (including any starchy and/or vegetable

accompaniments), two portions of each dessert and one portion of any jacket potato or sandwich options available to children within the nursery. Fewer jacket potato/sandwich options were collected as these were typically the same each day in each school. Kitchen staff were asked to provide these portions as would be given to a nursery child and on their normal plates or trays, and these were collected by a researcher each lunchtime. Schools were reimbursed for the cost of the lunches.

Each meal was separated into individual components (e.g., tortilla wrap, cheese filling, cucumber slices; roast chicken, roast potatoes, carrots, peas), and where possible, composite dishes were also separated into individual ingredients (e.g., chicken in a curry separated from the vegetables and sauce) using tweezers or a sieve where necessary. Each item was then weighed using kitchen scales (Salter), and portion weight data for each item were recorded to the nearest 1 g. Where relevant, only the edible parts of foods were weighed (e.g., by removing the peel from satsumas and the skin from melon before weighing), and edible portion weights were calculated for other foods (e.g., excluding the core weight from apples) using standard estimates.³⁸

Where multiple portion weights were available for a food item provided in a school on a particular day (e.g., where carrots were provided as a vegetable with the main meal and vegetarian option), a mean final weight was calculated for that item. Using food group guidance included within the voluntary food and drink guidelines for EYS, each food item was coded to record the broad food group to which it belonged (e.g., starchy foods) and also the specific food item within the broad food group (e.g., bread, cooked vegetables, meat/poultry). Separate codes were used to identify where starchy foods and vegetables were provided as a complete portion of food from that group, or as a partial portion, alongside another food from the same group. All data were recorded in an Excel spreadsheet and exported into SPSS for analysis.

Data analysis

Analysis of portion size data was conducted where a specific food item has been provided in two or more schools, which resulted in portion size data for 50 food items. For each food item, the number of schools where the item was provided and the total number of final portion weights were calculated, along with the mean and median portion weights, standard deviation, the 25th and 75th centile for portion weight and the coefficient of variation (CV). Where there was an odd number of data points, a Tukey's hinge was applied.

For each food item, the number and percentage of items provided that were within, below and above the typical portion size range for EYS²¹ were calculated. For some foods, typical portion sizes were expressed as a

single value rather than a range (e.g., typical portion size for cooked vegetables is stated as 40 g). For raw and cooked vegetables, beans within baked beans and fresh fruit, the single value stated was interpreted as a minimum portion size. For other foods where a single value was given as a typical portion size (e.g., egg, hot fruit-based desserts), portion sizes within 20% of the stated typical portion size were classified as within the typical portion size range. The number and percentage of items provided that were within, below and above typical portion sizes for primary schools³⁹ were also calculated. Where typical portion sizes for primary schools were given for raw/dried foods (e.g., the weight of dried rice rather than rice as served), typical portion sizes were converted to cooked weights using standard estimates of weight gain during cooking³⁸ to allow direct comparison.

RESULTS

Potatoes, bread, rice, pasta and other starchy carbohydrates

The portion size of starchy foods varied according to type, with average portion sizes ranging from 28 g (Yorkshire puddings) to 163 g (jacket potatoes) (Table 1). Jacket potatoes were the most frequently recorded starchy food, provided as an alternative meal option every day in nine schools. Fried potatoes, for example, chips, were served in all schools, but on fewer occasions and with a smaller average portion size (69 g) than boiled/mashed potato (95 g) and jacket potatoes (163 g). The way in which potato was served influenced the portion size, with mean portion sizes of boiled/mashed potato within the typical portion range for EYS, whilst jacket potatoes exceeded the range. Bread rolls, pitta bread or wraps were also served on most days in most schools, as sandwiches provided as a further alternative to the main meal. Portions of bread in sandwiches (mean 89 g) exceeded guidelines for both primary schools and EYS (Table 2). Bread rolls, however, were more likely to meet typical portion sizes for EYS and were also within the portion size range for primary schools. Average portion sizes of both rice and pasta were smaller than portions of potatoes, with rice (79 g) slightly below the typical range for EYS (80–100 g) and pasta (89 g) within range (Table 2) (Figure 1). Variation in portion size differed by food item, with more variation in portion sizes for pasta (CV: 0.47) and boiled/mashed potato (CV: 0.42) compared with Yorkshire pudding (CV: 0.20) and bread (CV: 0.03), which are typically purchased products served as individual items or a set number of slices.

Fruit and vegetables

Cooked vegetables were served in all 10 schools, fresh fruit in 9 schools and raw vegetable sticks in 6 schools

(Table 1). The average portion size of fruit and vegetables ranged from 24 g (bean weight within baked beans) to 77 g (fresh fruit). The portion size of raw fruit tended to be higher (77 g) than cooked (49 g) or raw vegetables (54 g), and the variation in portions was similar for cooked vegetables (CV: 0.47), raw vegetables (CV: 0.42) and fresh fruit (CV: 0.44). The typical portion size of fruit and vegetables recommended for EYS is 40 g, which we have interpreted as meaning at least 40 g. Only the average weight of baked beans (bean weight only) did not meet this, although 42% of cooked vegetable portions, 28% raw vegetables and 8% fresh fruit were less than 40 g (Table 2). Typical fruit and vegetable portion sizes for EYS are generally aligned to those within guidance for primary schools, so average portion sizes were equally aligned to guidance for this age group (Figure 1).

Beans, pulses, fish, eggs, meat and other pulses

Meat and poultry, meat alternatives and fish were served either alone or as part of a main dish and were provided in all 10 schools. Baked beans were provided as a protein source in nine schools, typically as a jacket potato filling, provided as an alternative to the main meal. Average portion weights for foods in this group ranged from 22 g (egg) to 68 g (fish as a jacket potato filling). Portion sizes also varied depending on how they were served; for example, fish as part of a main meal was generally provided as fish fingers, and the fish component (24 g) was smaller than the tuna component of tuna mayonnaise in a sandwich (34 g) or jacket potato (68 g) (Table 1). Variation in portion sizes was highest for pulses within a main dish (CV: 0.69) and for fish as a jacket potato filling (CV: 0.51). Typical portion sizes for EYS for foods from this group are generally 30–40 g. Portions of meat were more likely to be above or within this range (74%) than below range (26%) (Figure 1). Portions of fish were lower (24 g), with 91% below the typical range. Fish as a jacket potato filling, however, usually exceeded the range (89%). Portions of egg were notably small (22 g), with all portions below range (Table 2). Mean weight of meat alternatives was 49 g, with 60% within range. Average portions of pulses served as a protein option or as a jacket potato filling were within the typical portion size range (31 and 34 g, respectively) but were close to the bottom of the range (30–50 g), with 71% of pulses as a protein option, below 30 g (Figure 1).

Dairy and alternatives

Portion sizes for dairy foods ranged from 18 g (soft cheese) to 99 g (yoghurt). Hard cheese was provided as a jacket potato filling in nine schools and as a sandwich

TABLE 1 Portion weights (g) of foods as served to 3- to 4-year-old children at 10 primary schools.

Food group and item	Number of schools serving food item	Total number of portion weights	Mean portion size (g)	Median portion size (g)	SD	25th centile	75th centile	CV
Potatoes, bread, rice, pasta and other starchy carbohydrates								
Bread	5	5	89	89	2	87	91	0.03
Bread roll/muffin/pitta/wrap	7	25	62	55	21	50	76	0.33
Boiled/mashed potato	5	5	95	91	40	62	132	0.42
Jacket potato	9	42	163	162	37	132	190	0.23
Fried potato, e.g., chips/roast potato/waffles	10	17	69	64	27	47	97	0.39
Pasta/noodles	2	3	89	90	42	47	110	0.47
Rice	4	4	79	84	29	49	104	0.37
Yorkshire pudding	2	3	28	28	6	22	31	0.20
Fruit and vegetables								
Cooked vegetables	10	45	49	44	23	29	69	0.47
Raw vegetables/vegetable sticks	6	29	54	56	23	36	73	0.42
Baked beans (beans only, sauce weight excluded)	4	8	24	23	4	21	29	0.17
Fresh fruit	9	40	77	71	34	51	96	0.44
Dried fruit	3	6	30	26	10	25	35	0.34
Beans, pulses, fish, eggs, meat and other protein								
Meat/poultry by itself/in main dish	10	31	41	45	15	27	49	0.37
Meat/poultry as a sandwich/roll/wrap filling	7	11	31	32	11	21	38	0.37
Fish by itself/in main dish	10	11	24	24	5	19	29	0.22
Fish as a jacket potato filling	7	9	68	70	35	43	92	0.51
Fish as sandwich/roll/wrap filling	5	7	34	29	12	25	46	0.35
Egg	4	3	22	22	7	15	26	0.32
Meat alternatives, e.g., Quorn by itself/in main dish	10	20	49	48	16	42	58	0.33
Pulses in main dish	5	7	31	27	21	11	60	0.69
Baked beans as a jacket potato filling (beans only, sauce weight excluded)	9	22	34	33	12	23	43	0.36
Dairy and alternatives								
Hard cheese as a jacket potato filling	9	23	30	34	12	23	37	0.39
Hard cheese as a sandwich/roll/wrap filling	8	19	29	23	13	19	40	0.44
Soft cheese, e.g., cheese spread	4	4	18	18	1	17	18	0.03
Yoghurt	6	24	99	100	18	85	110	0.18
Custard	6	10	29	28	15	18	37	0.52
Desserts, puddings and cakes								
Fruit crumble/pie	2	3	99	97	26	75	112	0.26

(Continues)

TABLE 1 (Continued)

Food group and item	Number of schools serving food item	Total number of portion weights	Mean portion size (g)	Median portion size (g)	SD	25th centile	75th centile	CV
Cake/muffin (containing fruit)	5	6	51	53	12	41	59	0.24
Cake/muffin (not containing fruit)	9	22	58	55	25	38	83	0.43
Biscuit (containing fruit)	2	2	39	39	13	29	48	0.35
Biscuit (not containing fruit)	5	12	49	43	19	35	56	0.39
Flapjack (not containing fruit)	4	4	53	47	17	41	71	0.32
Jelly	6	9	81	84	31	59	111	0.39
Ice cream	5	5	54	38	27	38	78	0.50
Other food items								
Macaroni cheese	4	4	176	173	55	124	230	0.31
Pizza	8	9	56	52	17	46	76	0.30
Pastry	5	6	75	68	40	49	102	0.53
Stuffing	4	4	19	20	3	17	22	0.15
Gravy	9	10	22	22	8	16	30	0.36
Condiments, e.g., ketchup	3	4	12	7	12	4	24	1.03

Abbreviations: CV, coefficient of variation; SD, standard deviation.

filling in eight schools, with mean portion weights of 30 and 29 g, respectively (Table 1). Hard cheese as a jacket potato or sandwich filling had a mean weight above the typical range (15–20 g), with 78% of cheese as a jacket potato filling and 68% of cheese as a sandwich filling above range (Table 2). Yoghurts (provided in six schools) and soft cheeses (provided in four schools) were typically provided as products pre-portioned by the manufacturer (pots of yoghurt, soft cheese triangles) accounting for the low variation in portion sizes for these foods (CV: 0.18 and 0.03, respectively). Whilst the yoghurts (99 g) exceeded the typical portion range of 50–75 g for EYS, soft cheese (18 g) fell below range (20–25 g). Custard (mean: 29 g) also fell below the range for 90% of portions (Figure 1).

Desserts, puddings and cakes

Although desserts were provided in all schools, very few of those observed contained any fruit. Cakes not containing fruit were served in more schools (nine) than cakes containing fruit (five). Mean portion sizes were larger when there was no fruit (58 vs. 51 g), and variation in portion sizes was also greater for cakes not containing fruit (CV: 0.43) than cakes containing fruit (CV: 0.24). Biscuits not containing fruit were also served more often (five compared with two schools) and were also larger than those containing fruit (49 vs. 39 g). Although flapjacks with no fruit (53 g) were served at four schools, only one school provided a flapjack with fruit, which was

excluded from the analysis (40 g, data not shown). Typical portion sizes for EYS are available only for desserts, cakes and biscuits containing fruit. The mean portion size for cakes containing fruit (51 g) was above the typical range for EYS (35–40 g), with 83% portions larger than this range. Fruit was available as an alternative to the main dessert in all schools (see fruit and vegetables section), and other commonly observed foods provided as dessert were jelly (six schools) and ice cream (five schools) for which no typical portion sizes for EYS are available.

Composite dishes

Due to the small sample of 10 schools, few dishes appeared enough times to create an average, but dishes that appeared more than twice were included in the analysis. Macaroni cheese was served in four schools (176 g), and pizza was served in eight schools (56 g) (Table 1).

Partial portions

In some cases, multiple portions from the same food group were provided as part of a lunch (Table 3). Where this was the case, all portions (of individual foods) were considered ‘partial portions’, which made up a whole portion or serving of food for that food group. For example, where Yorkshire puddings and roast

TABLE 2 Portion weights (g) of foods as served to 3- to 4-year-old children in 10 primary schools.

Food group and item	Total number of portion weights	Mean portion size (g)	Typical portion sizes (g) for EYS	Number (%) of portions within typical range for EYS	Number (%) of portions below typical range for EYS	Number (%) of portions above typical range for EYS	Typical portion sizes (g) for primary schools	Number (%) of portions within typical range for primary schools	Number (%) of portions below typical range for primary schools	Number (%) of portions above typical range for primary schools	
Potatoes, bread, rice, pasta and other starchy carbohydrates											
Bread	5	89	20–30	0 (0)	0 (0)	5 (100)	50–70	0 (0)	0 (0)	5 (100)	
Bread roll/muffin/pitta/wrap	25	62	25–50	9 (36)	1 (4)	15 (60)	50–70	14 (56)	4 (16)	7 (28)	
Boiled/mashed potato	5	95	80–100	1 (20)	2 (40)	2 (40)	108–153	0 (0)	4 (80)	1 (20)	
Jacket potato	42	163	80–100	1 (2)	0 (0)	41 (98)	150–210	19 (45)	18 (43)	5 (12)	
Pasta/noodles	3	89	80–100	1 (33)	1 (33)	1 (33)	100–145	1 (33)	2 (67)	0 (0)	
Rice	4	79	80–100	1 (25)	2 (50)	1 (25)	93–146	1 (25)	3 (75)	0 (0)	
Fruit and vegetables											
Cooked vegetables	45	49	40	26 (58)	19 (42)	N/A	40–60	12 (27)	19 (42)	14 (31)	
Raw vegetables/vegetable sticks	29	54	40	21 (72)	8 (28)	N/A	40–60	7 (24)	8 (28)	14 (48)	
Baked beans (beans only, excluding sauce)	8	24	40	0 (0)	8 (100)	N/A	50–70	3 (38)	5 (63)	0 (0)	
Fresh fruit	40	77	40	37 (93)	3 (8)	N/A	40	37 (93)	3 (8)	N/A	
Dried fruit	6	30	15–30	5 (83)	0 (0)	1 (17)	15–30	5 (83)	0 (0)	1 (17)	
Beans, pulses, fish, eggs, meat and other protein											
Meat/poultry	31	41	30–40	5 (16)	8 (26)	18 (58)	31–63	21 (68)	8 (26)	2 (6)	
Meat/poultry in a sandwich/wrap	11	31	30–40	5 (45)	4 (36)	2 (18)	31–63	7 (64)	4 (36)	0 (0)	
Fish	11	24	30–40	1 (9)	10 (91)	0 (0)	50–75	0 (0)	11 (100)	0 (0)	
Fish as a jacket potato filling	9	68	30–40	0 (0)	1 (11)	8 (89)	50–70	1 (11)	4 (44)	4 (44)	
Fish in a sandwich/wrap	7	34	30–40	1 (14)	4 (57)	2 (29)	50–70	1 (14)	6 (86)	0 (0)	
Egg	3	22	50	0 (0)	3 (100)	0 (0)	50	0 (0)	3 (100)	0 (0)	
Meat alternatives, e.g., Quorn	20	49	30–50	12 (60)	1 (5)	7 (35)	50–70	5 (25)	13 (65)	2 (10)	

(Continues)

TABLE 2 (Continued)

Food group and item	Total number of portion weights	Mean portion size (g)	Typical portion sizes (g) for EYS	Number (%) of portions within typical range for EYS	Number (%) of portions below typical range for EYS	Number (%) of portions above typical range for EYS	Typical portion sizes (g) for primary schools	Number (%) of portions within typical range for primary schools	Number (%) of portions below typical range for primary schools	Number (%) of portions above typical range for primary schools	
Pulses	7	31	30–50	0 (0)	5 (71)	2 (29)	50–60	1 (14)	5 (71)	1 (14)	
Baked beans as a jacket potato filling (beans only, sauce weight excluded)	22	34	30–50	13 (59)	8 (36)	1 (5)	50–70	7 (32)	6 (27)	9 (41)	
Dairy and alternatives											
Hard cheese as a jacket potato filling	23	30	15–20	2 (9)	3 (13)	18 (78)	20–30	6 (26)	5 (22)	12 (52)	
Hard cheese as a sandwich/roll/wrap filling	19	29	15–20	6 (32)	0 (0)	13 (68)	20–30	5 (26)	6 (32)	8 (42)	
Soft cheese, e.g., cheese spread	4	18	20–25	0 (0)	4 (100)	0 (0)	20–30	0 (0)	4 (100)	0 (0)	
Yoghurt	24	99	50–75	0 (0)	0 (0)	24 (100)	80–120	23 (96)	0 (0)	1 (4)	
Custard	10	29	50–75	1 (10)	9 (90)	0 (0)	80–100	0 (0)	10 (100)	0 (0)	
Desserts, puddings and cakes											
Hot fruit-based desserts, e.g., crumble/pie	3	99	60	1 (33)	0 (0)	2 (67)	80–100	1 (33)	1 (33)	1 (33)	
Cake/muffin (containing fruit)	6	51	35–40	0 (0)	1 (17)	5 (83)	40–50	2 (33)	1 (17)	3 (50)	

Notes: Comparison to typical portion size guidance for early years' settings²¹ and primary schools.³⁹ Where typical portion size guidance for schools was expressed as raw/dried weights, typical portion sizes as served were calculated using standard estimates of weight change during cooking to enable direct comparison.

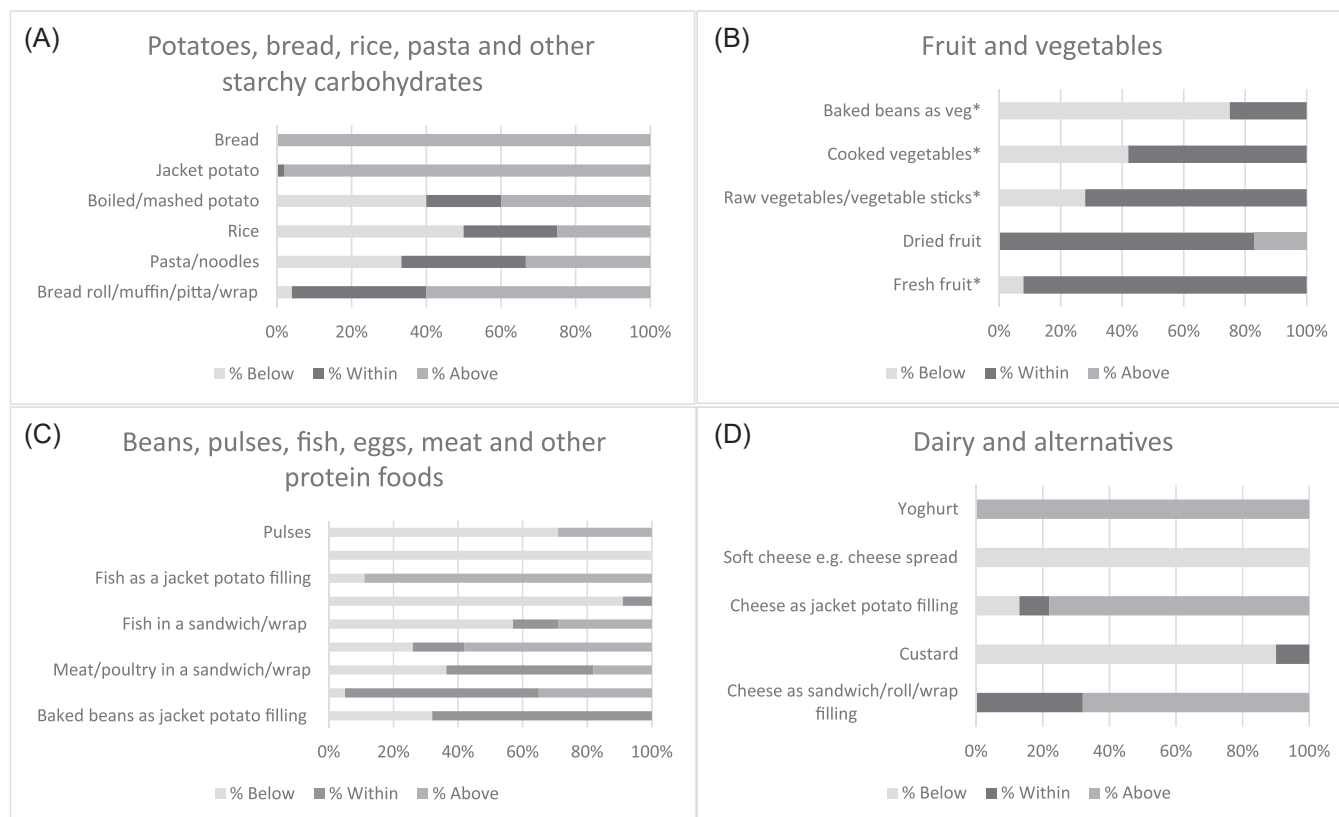


FIGURE 1 Percentage of food items below, within and above the typical portion size range for EYS by food group. (A) Potatoes, bread, rice, pasta and other starchy carbohydrates, (B) Fruit and vegetables, (C) Beans, Pulses, fish, eggs, meat and other protein foods, (D) Dairy and alternatives. *Food items where typical portion size is interpreted as a minimum portion size.

potatoes were provided together at the same meal, these were considered partial portions of starchy carbohydrates. Where several partial portions were provided together, the mean weight of each portion was generally lower, compared with where only one starchy food was provided. For example, where fried potatoes were provided alongside another carbohydrate, the mean portion weight was 54 g, compared with 69 g, when provided as a complete portion. This was also seen for cooked vegetables where the average weight was 49 g if provided alone and 37 g if provided alongside a second portion of vegetables. The degree to which the portion size of a food was reduced if being served alongside another food from the same group varied between foods; for example, the mean portion weight of bread rolls/muffin/pittas/wraps when served alongside another starchy food was approximately 70% of the weight of a complete portion, but the mean portion sizes for pasta and rice reduced only slightly when another starchy food was also served, compared with when they were the sole starchy food (with partial portion weights of 98% and 94% of the complete portion weight, respectively).

The only foods where this was not the case were baked beans, which weighed slightly more as a partial portion (28 g) than as a complete portion (24 g), and

Yorkshire puddings, which weighed more as a partial portion (47 g) than a complete portion (28 g).

DISCUSSION

This study found that caterers reported serving the same-sized portions to both 3–4-year-olds and 4–7-year-olds (reported in 9 of 10 schools). For food items falling outside of the typical range for EYS, these were more common because the portion sizes were above the range (10 food items) than below it (6 food items). When compared with primary school portion sizes however, portion weights falling outside of the recommended range were usually too small (12 of 14 items). Some foods commonly provided by the schools in the study did not have typical portion sizes for EYS listed as part of the voluntary food and drink guidelines, as they were not considered ‘good choices of foods to serve’,²¹ making appropriate sizing of portions of these foods a challenge for caterers. Where partial portions were provided, the total portion of a food group was often larger than recommended. These results suggest that caterers may not be following guidelines that are appropriate for all the children in the different age groups they are catering to.

TABLE 3 Portion weights (g) of foods as served, where foods were served as partial portions (a food alongside other foods from the same food group) for 3- to 4-year-old children in 10 schools.

Food group and item	Typical portion sizes (g) for early years' settings	Total number of portion weights collected – complete portion	Mean portion weight, g (SD) – complete portion	Total number of portion weights collected – partial portion	Mean portion weight, g (SD) – partial portion	Mean partial portion weight as % of complete portion weight
Potatoes, bread, rice, pasta and other starchy carbohydrates						
Bread	20–30	5	89 (2)	2	16 (1)	18
Bread roll/muffin/pitta/wrap	25–50	25	62 (21)	19	43 (18)	69
Boiled/mashed potato	80–100	5	95 (40)	7	81 (31)	85
Fried potato, e.g., chips/roast potato/waffles	N/A	17	69 (27)	27	54 (26)	78
Pasta/noodles	80–100	3	89 (42)	10	87 (30)	98
Rice	80–100	4	79 (29)	6	74 (21)	94
Yorkshire pudding	N/A	3	28 (6)	2	47 (34)	167
Fruit and vegetables						
Cooked vegetables	40	45	49 (23)	28	37 (11)	76
Baked beans served as a vegetable	40	8	24 (4)	3	28 (10)	116

Abbreviations: N/A, not available; SD, standard deviation.

Typical portion sizes are usually higher in primary school guidance than in guidance for EYS. If similarly sized portions were served to both 3–4-year-olds and 4–5-year-olds, we would expect to observe portion sizes more consistent with primary school guidance, but this was not the case. Mean portion sizes were almost equally likely to fall in the typical range for EYS (11/27 items) or primary schools (13/27 items) (Table 2).

Portion sizes of baked beans when served as a vegetable, fish within a main meal, egg, soft cheese and custard were particularly low in comparison to typical portion sizes for EYS, with at least 90% of portions of each falling below the typical range. These foods represent good sources of micronutrients, intakes of which may be low in young children's diets.¹² As it is challenging to achieve adequate amounts of micronutrients within schools and EYS lunches,^{40,41} it is important that adequate portion sizes of these foods are provided to meet children's nutritional requirements. Portion sizes of bread, jacket potatoes, fish as a jacket potato filling, hard cheese, yoghurt, fruit-based desserts and cakes containing fruit were all above the typical portion size range for EYS, with mean portion sizes for bread and cakes containing fruit also higher than the typical range for primary school portions. These may represent foods that are more likely to be popular with children and where staff have fewer concerns about wastage associated with unfinished meals.

Whether the mean weight of food items was within the portion size range for EYS varied within food groups; for example, for starchy foods, mean portion sizes for boiled/mashed potato and pasta were within the range, but rice was below the range, and jacket potato, bread and bread rolls/muffins/pitta/wraps were above the range. In some cases, this also varied depending on how a particular food was served. For example, fish was served in all schools as fish fingers, but the mean fish content of these once the batter was removed was far below the typical portion size range for EYS, whereas tuna served in a sandwich was within the range and tuna served with a jacket potato was above the range. Consumption of fish by children in England is reported to be low, with an average of only 8 and 11 g consumed daily by 1.5–3-year-olds and 4–10-year-olds, respectively.¹² Oily fish consumption is reported at less than 20 g per week.¹² The variation in portion size is clearly connected to the way fish is served. It could be that two fish fingers 'look' like an appropriate portion size, despite the fish content being low. Similarly, a portion of tuna mayonnaise meeting recommendations may 'look' small on a jacket potato. Liz Martins and Marques²³ observed that cooks do not determine portion sizes accurately, and this may be the case here. Interestingly, although the school food standards require provision of oily fish at least once every 3 weeks, we did not observe oily fish as part of this study, supporting the observation of low intake recorded for children by the National Diet and Nutrition Survey¹²

and potentially representing a missed opportunity to familiarise children with it.

For the 14 food items with mean weights outside of the typical range for primary school lunches, this was more common because portion sizes were below the typical range (12 items) than above it (2 items). In addition to the six foods below the typical range for EYS, mean portion weights for boiled/mashed potato, pasta, fish in sandwiches, meat alternatives, pulses and baked beans as a jacket potato filling were below typical portion sizes for primary schools. This could be of concern if, as reported, the observed portion sizes are also provided for primary-aged children, as it may indicate that portion sizes for this wider range of foods are inadequate for this age group. Although previous research has reported portion sizes provided for children aged 4–11 years in primary schools,^{35,36} this was published before current portion size guidance for schools was published,¹⁹ and research on portion sizes since then is lacking.

In some cases, practicalities may restrict the ability of caterers to vary portion sizes in line with guidance for EYS and primary-aged children. For example, some food items were typically provided as individually packaged items, which avoids the need for portioning but limits flexibility in ensuring appropriate portion sizes. For example, cheese spread was provided with crackers as a dessert in four schools, but the standard portion size of a cheese spread triangle (18 g) is just below the typical portion size for both EYS and primary schools. Similarly, yogurt was provided in individual pots ranging from 80 to 150 g, so portions were generally in line with portion size guidance for primary schools but above the typical range for EYS. Other items where portion sizes were outside of typical ranges may also be due to constraints related to product sizes, for example, weight of slices of bread and tortilla wraps, purchased Yorkshire puddings, or individual variation within foods such as the size of baking potatoes where a whole potato is typically served, or fruit where a whole piece of fruit is offered as a dessert option.

A further challenge for caterers may be the lack of portion size guidance for some food items. Unlike guidance for primary and secondary schools¹⁹ which includes typical portion sizes for foods that should be limited (e.g., potatoes cooked in oil, meat products, cakes), the guidance for EYS includes only typical portion sizes for 'good choices of foods to serve'.²¹ Therefore, there were foods commonly provided by schools, and which can be provided in menus meeting the food and drink guidelines, but for which typical portion sizes for EYS were not available. These included fried potatoes such as chips (provided in all 10 schools); cakes, biscuits and flapjacks not containing fruit (10 schools); pizza (8 schools); jelly (6 schools); ice cream (5 schools); and Yorkshire pudding (4 schools). In guidance for schools, typical portion sizes for fried starchy foods are

lower than those for plain starchy foods, due to the increased energy content. This was observed in this study, suggesting caterers are following the principles included in the portion size guidance for school-aged children, the predominant age group catered to. Previous research (conducted prior to the publication of current portion size guidance for primary schools) indicated that portion sizes of cakes provided in primary schools were too large,³⁵ and the findings from the current study suggest portion sizes remain excessive. Variability in portion size was also consistently higher for cakes and biscuits not containing fruit when compared with those containing fruit. As cakes, buns, pastries and biscuits are a key contributor to free sugar intake in young children, and intake of free sugars is approximately double the dietary recommendation in this age group,¹² reducing portion sizes of these foods in line with typical portion sizes could help ensure greater consistency between dessert provision and current dietary recommendations. As caterers generally reported serving the same portions to 3–4-year-old children as to infants, it appears unlikely that the typical portion sizes for EYS were utilised in these settings, but provision of typical portion sizes of commonly served foods (even when not considered good choices of foods to serve) may be useful in providing guidance on typical portion sizes of energy-dense foods.

Including fruit in cakes, biscuits and desserts is also an easy way for caterers to increase consumption of fruit and vegetables among children. What was surprising in this study was the lack of fruit-based desserts and the ubiquity of cakes and biscuits (10 schools). It was not clear from the data whether children could take fruit alongside a non-fruit dessert; however, given average portion sizes (77 g for fruit and 58 g for cakes and biscuits without fruit), eating these together would provide a very large dessert option for 3–4-year-old children. Portions of vegetables were smaller than portions of fruit but, except for baked beans, exceeded 40 g.

Previous research on food provision in EYS has typically been conducted using a questionnaire focusing on reported food practices^{30–32} or has involved nutritional analysis of planned menus, and therefore, data on portion sizes of foods provided for children attending EYS with which to compare the findings of this study are lacking.³² One study of food provision in EYS reported portion sizes but estimated these using a different method to the current study and included all types of EYS rather than school-based nurseries specifically.³³ Mean portion sizes were smaller than those seen in the current study for all food items where direct comparison was possible, but this is likely due to reporting of mean portion sizes for the complete age range for which the voluntary food and drink guidelines apply (1–4 years), rather than focusing specifically on 3–4-year-old children as in the current study. Meanwhile, previous research on primary school portion sizes³⁵ indicated high variation in

the provided portion sizes for some food items, which is consistent with the findings from this study.

There are several limitations to the findings. The portion size data were collected from 10 schools, purposively sampled in a relatively small geographical area and may not be representative of wider provision. The number of individual portion weights used to calculate the mean portion for some foods (particularly those served infrequently or only in a small number of schools) is small. Although caterers were asked to provide portions as would be served to children attending the nursery, on the normal plates or trays used, they were aware of the study and may have consciously or subconsciously changed the size of portions provided (e.g., reducing portions provided to reduce wastage as the food was not being eaten by children within the school). Finally, in some cases children had access to salad bars and were encouraged to help themselves to these in addition to the food served, and portion sizes reported in this study did not include this additional food available to children. Despite these limitations, the information presented provides details of portion sizes provided to 3–4-year-old children accessing early years' education in a school setting, which has not been specifically detailed in previous research conducted in either EYS or schools.

CONCLUSION

This study aimed to explore the portion sizes served within school-based EYS. We found that portion sizes were often outside the recommended range for children attending EYS but were not consistently larger or smaller than the recommended range. However, some energy-dense foods such as cakes and biscuits had large portion sizes, consistent with previous studies. The type of food or the way in which food is served may influence the portion size, possibly depending on whether the portion 'looks' appropriate. Also, caterers revealed portions were the same size as those provided to infant children in the schools.

Our findings suggest that although there is a wealth of guidance available to caterers, providing food which satisfies the needs of both EYS and school children may be challenging. Also, foods without portion sizes for EYS, because they were not 'good choices of foods to serve', should be included in any new guidance. Future research should explore whether the meals meet food-based guidelines for both schools and EYS. Assessment of menus against the underlying nutrient frameworks for schools and EYS will allow the impact of portion size to be further explored.

AUTHOR CONTRIBUTIONS

Jo Pearce and Claire J. Wall designed the study, collected data, performed analysis and wrote the manuscript.

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CONFLICT OF INTEREST STATEMENT

C.J.W. was involved in the development of voluntary guidelines for EYS in England and has previously worked with Action for Children. J.P. declares no conflict of interest.

DATA AVAILABILITY STATEMENT

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

TRANSPARENCY DECLARATION

The lead author affirms that this manuscript is an honest, accurate and transparent account of the study being reported. The reporting of this work is compliant with STROBE guidelines. The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study as planned have been explained.

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PEER REVIEW

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