

How big is a food portion? A pilot study in Australian families

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Abstract

Issues addressed: It is not known whether individuals can accurately estimate the portion size of foods usually consumed relative to standard serving sizes in national food selection guides. The aim of the present cross-sectional pilot study was to quantify what adults and children deem a typical portion for a variety of foods and compare these with the serving sizes specified in the Australian Guide to Healthy Eating (AGHE).

Methods: Adults and children were independently asked to serve out their typical portion of 10 common foods (rice, pasta, breakfast cereal, chocolate, confectionary, ice cream, meat, vegetables, soft drink and milk). They were also asked to serve what they perceived a small, medium and large portion of each food to be. Each portion was weighed and recorded by an assessor and compared with the standard AGHE serving sizes.

Results: Twenty-one individuals (nine mothers, one father, 11 children) participated in the study. There was a large degree of variability in portion sizes measured out by both parents and children, with means exceeding the standard AGHE serving size for all items, except for soft drink and milk, where mean portion sizes were less than the AGHE serving size. The greatest mean overestimations were for pasta (155%; mean 116 g; range 94–139 g) and chocolate (151%; mean 38 g; range 25–50 g), each of which represented approximately 1.5 standard AGHE servings.

Conclusion: The findings of the present study indicate that there is variability between parents' and children's estimation of typical portion sizes compared with national recommendations.

So what? Dietary interventions to improve individuals' dietary patterns should target education regarding portion size.

Key words: children, parents, portion size perception, standard serving size.

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Introduction

Serving sizes in food selection guides, including the Australian Guide to Healthy Eating (AGHE),¹ define specific amounts of foods, along with the number to consume based on age, sex and life stage in order to optimise nutrient intakes. These standard serving sizes allow evaluation of intakes of specific food groups, and comparison of intakes between population groups and over time. Serving size differs from portion size, which is the amount of food or beverage that an individual intends to consume in a single eating occasion.

Discrepancy also exists between product-specific serving sizes created by food manufacturers and individual consumer beliefs about what constitutes a typical food portion. Research shows that an individual's serving sizes are influenced by environmental factors.

Several experimental studies demonstrate that lighting, socialising, package size and the size of the portion offered greatly influence the amount consumed.^{2,3}

At the same time, evidence suggests that being aware of how much you eat is key to consuming a more healthy diet or attempting to lose weight.⁴ Therefore, knowledge of what constitutes a recommended serving size is important if individuals are to reliably report intake, to self-monitor what they are consuming or to adhere to national dietary guidelines.

Although food photographs have been validated as aides for portion size estimation,⁵ no studies have evaluated the agreement between standard serving sizes with what adults and children actually perceive

as typical servings using a practical assessment with self-served real foods. Asking individuals to estimate their typical portion size using real food, may allow for improved characterisation of portion size estimation errors. The primary aim of the present study was to compare what adults and children deem as typical portions of a variety of foods with the standard serving sizes defined within the national food selection guide. A secondary aim of the study was to assess participants' perceptions of small, medium and large portion sizes.

Methods

Participants and recruitment

Adult and child (aged 8–12 years) participants who had previously completed the Family Diet Quality Study (FDQS)⁶ were invited to participate in the present study ($n=68$). The FDQS validated a food frequency questionnaire⁶ and diet quality score for adults.⁷ Participants were recruited from a regional (Newcastle) and rural (Forster) area in New South Wales (NSW), Australia, during April–May 2012. The only inclusion criteria were that participants had to be willing and able to serve themselves food portions at an assessment session. Parents provided written informed consent, and children

provided assent. The study was approved by the University of Newcastle Human Research Ethics Committee.

Study design

Using a cross-sectional design, participants attended a single measurement session at either the University of Newcastle ($n=14$) or Forster Community Health Centre ($n=7$).

Assessment of portion size

All participants were advised to refrain from eating or drinking for at least 1 h before the assessment session to standardise satiety and hunger.⁸

Ten food stations (one station per food) were prepared containing rice, breakfast cereal, soft drink, milk, mixed vegetables, steak, pasta, confectionary, ice cream, chocolate and potato crisps. These foods were chosen to represent categories of the AGHE, with an over-representation of items from the energy-dense, nutrient-poor category, because these foods are commonly consumed in amounts greater than recommended.^{9,10} All food used for the assessment was removed from packaging and cooked if required (Table 1). Stations consisted of the food item presented in a large glass serving bowl as an amount that a family of four may consume. Ice-cream was presented in a 2-L container (typical purchased container size) and

Table 1. Description of foods used in the portion size study

Note, the 'large-sized' serving spoon was approximately 60 mL. UHT, ultra heat treated; AGHE, Australian Guide to Healthy Eating; N/A, not applicable

Food type	Description	AGHE food group	Cooking method	Total amount of food offered to serve from	Presentation of food (vessels and serving utensils)
Rice	Jasmine rice	Breads and cereals	Boiled/steamed	3–4 cups cooked	Large glass serving bowl, large serving spoon
Pasta	Spaghetti	Breads and cereals	Boiled	3–4 cups cooked	Large glass serving bowl, large serving spoon
Breakfast cereal	Puffed wheat, rice flakes with small pieces of dried fruit	Breads and cereals	N/A	500 g	In the box
Meat	Beef chuck steak	Meat/poultry/legumes	Browned in frypan	1 kg	Large glass serving bowl, large serving spoon
Vegetables	Frozen mixed vegetables (carrot, broccoli, cauliflower, peas, corn)	Vegetables	Steamed	1 kg	Large glass serving bowl, large serving spoon
Milk	Long-life UHT whole milk	Dairy	N/A	2 L	In a glass serving jug
Soft drink	Cola	Discretionary	N/A	1.5 L	In a glass serving jug
Lollies and/or confectionary	Mixed jelly type (jelly babies and/or snacks)	Discretionary	N/A	600 g	Large glass serving bowl, tongs
Chocolate	Milk chocolate block	Discretionary	N/A	200 g (broken into pieces)	Large glass serving bowl, tongs
Ice cream	Vanilla	Discretionary	N/A	2 L	Straight from container, ice cream scoop
Potato crisps	Original potato crisps	Discretionary	N/A	185 g	Large glass serving bowl, tongs

was only assessed in the Newcastle group, because freezer facilities were not available at the Forster location. The participants were instructed to bring their own usual serving vessels (e.g. bowl, plate, cup) from home to improve estimation accuracy of their portion sizes.

At each station, participants served themselves the typical amount of the food that they consumed at a meal or in one sitting in the serving vessel. They were asked to include any additional amounts they would serve themselves (i.e. 'seconds'). If their typical portion exceeded the capacity of the serving vessel, all amounts were added into the portion so that the participant achieved the amount they perceived as typical for one eating occasion. Each station had a set of electronic kitchen scales (accuracy ± 1 g; Soehnle-Waagen, Murrhardt, Germany). Served food portions were weighed by a trained assessor. Participants were then asked to sequentially serve themselves what they considered to be small, medium and large portions of the food. The foods were not consumed.

Statistical analysis

The difference between the self-served portions (mean \pm s.d.) and standard AGHE serves were calculated (Table 2) and presented as proportions (self-serve portion (g)/AGHE standard serving (g) \times 100). Differences between groups (parents and children) and differences from the AGHE were determined using dependent sample *t*-tests, with significance set at $P < 0.05$. Analyses were performed using SPSS version 19 (IBM Corp, Armonk, NY).

Results

In all, 21 participants (10 parents (nine mothers; one father) and 11 children (five boys and six girls)) participated in the study, representing 21% of the FDQS participants.⁷ The mean (\pm s.d.) age of the parents and children was 44.2 ± 3.9 and 10.2 ± 1.3 years, respectively. Seventy-six per cent of subjects (16/21) reported consuming their last meal at least 1 h before the session, with the remainder reporting > 2 h. Comparisons with standard serving sizes in the AGHE and participant estimates of small, medium and large serves are given in Table 2. Participants' small portion was most similar to the standard AGHE serving sizes.

Although the mean typical portion sizes served by both parents and children varied from the standard AGHE serving sizes for all foods, except for soft drink and milk, which were smaller, the 95% confidence intervals (CI) highlight the large degree of variability. There were significant differences ($P < 0.05$) reported between typical portions and AGHE servings for both parents and children for soft drink, vegetables and pasta, whereas rice, milk and pasta portions were significantly different to the AGHE for parents only. There were significant differences (Table 2) in perceptions of 'typical' portions for confectionary between parents (40.4 ± 22.6 g; 100.9% of AGHE serving size) and children (98.9 ± 50.6 g; 247.2%; $t = -2.98$, $P < 0.01$), as well as small ($t = -2.91$, $P < 0.01$), medium ($t = -2.22$, $P < 0.04$) and large ($t = -2.23$, $P < 0.04$) portions, with child perceptions almost

double those of parents. Significant differences were also found between parents and children for the small ($t = 2.07$, $P < 0.05$), medium ($t = 2.38$, $P < 0.03$) and large ($t = 2.50$, $P < 0.02$) portions of soft drink, with parent perceptions larger than those of the children ($P < 0.05$).

Discussion

Estimation of portion size is fundamental to obtaining accurate self-reported dietary intake; whether these data inform individuals about their own habits or researchers seeking accurate dietary information at the individual or population level, accurate estimation is important. The results of the present study demonstrate that self-selected portion sizes of common foods vary from the standard serving sizes specified in the AGHE for both adults and children, except for soft drink and milk. There was disparity between typical portion size for confectionery, with parents reporting portion sizes closely aligned with the AGHE serving size (101%), whereas children reported almost double that specified in the AGHE (247%). It is possible that for confectionery children are more likely to serve themselves what they would like to eat and that the portion parents would give to their children would be smaller.

These findings suggest that dietary assessment methods that rely on self-assessment of serving sizes based on national food selection guides should be complemented with real food or realistic images of the specified serving size. In these settings, participants should be asked to indicate how their typical portion size differs from these standard servings. When using a semiquantitative food frequency questionnaire (FFQ) that uses prespecified portion sizes, it should be ensured that these represent typical portion sizes from a reference population and not national food selection guide serving sizes. Many FFQs apply a standard portion size factor from population-based studies to the food items in order to estimate nutrient intake, whereas some allow individuals to select typical portions consumed.¹¹ Given that individual variation exists in portion size, evaluating the performance of estimation methods that allow individuals to provide more detailed information on their portions size is an important area of research.

Limitations of the study include the parents, but not children's, previous participation in the diet quality study; this may have biased the portion size estimates of the parents. However, if this were true, one would have expected to see reduced portion sizes of discretionary foods, such as chocolate and confectionary. Soft drink and milk commonly come in preprepared packages of single portions (i.e. cans of soft drink or single-serve cartons of milk). Thus, individuals may be more familiar with standard serving sizes and may have reduced their self-selected portion based on the serving vessels available. Other limitations include the small sample size, number of foods assessed and the relatively high socioeconomic status of the FDQS participants, which may limit the generalisability of the results. A selection bias may have also contributed to the study's

Table 2. Reported portion sizes of typical, small, medium and large portion sizes (grams) of common foods, as estimated by parents and children in the portion size study

Data are given as the mean \pm s.d. Bolded values indicate a significant difference between reported intake and the Australian Guide to Healthy Eating (AGHE) portion size ($P < 0.05$). * $P < 0.05$ compared between parent and child estimates; *Mean proportion of AGHE* is the mean estimated serve size served by participants divided by the recommended portion sizes as reported in the AGHE. CI, confidence interval

Food (AGHE serve size)	Participants	Measure	Typical portion	Self-served portion		
				Small portion	Medium portion	Large portion
Cereal (30 g)	Parents ($n = 10$)	Mean (95% CI) portion size (g)	35.2 (15.5–54.9)	19.1 (10.9–27.4)	37.1 (18.9–55.2)	59.1 (32.6–85.6)
		Mean (range) proportion of AGHE serve (%)	117.3 (16–111)	63.6 (9–49)	123.7 (23–108)	197.0 (36–161)
		Mean difference (range) vs AGHE serve (g)	5.2 (–14.5, 24.9)	–10.9 (–19.1, –2.6)	7.1 (–11.0, 25.2)	29.1 (2.6, 55.6)
	Children ($n = 9$)	Mean (95% CI) portion size (g)	41.9 (20–63.7)	20.8 (7.8–33.6)	37.1 (18.7–56.4)	63.7 (30.5–97.8)
		Mean (range) proportion of AGHE serve (%)	139.5 (20–78)	69.3 (7–45)	123.7 (14–69)	212.2 (17–112)
		Mean difference (range) vs AGHE serve (g)	11.8 (–10.0, 33.7)	–9.2 (–22.2, 3.6)	7.5 (–11.2, 26.4)	34.1 (0.49, 67.7)
Rice (80 g)	Total ($n = 19$)	Mean (95% CI) portion size (g)	37.9 (24.9–51)	19.9 (13.5–26.1)	37.1 (25.6–48.9)	61.3 (42.8–79.6)
		Mean (range) proportion of AGHE serve (%)	126.5 (16–111)	66.3 (7–49)	123.7 (14–108)	204.2 (17–161)
		Mean difference (range) vs AGHE serve (g)	7.9 (–5.1, 21)	–10.2 (–16.5, –3.9)	7.2 (–4.4, 18.9)	31.2 (12.8, 49.5)
	Parents ($n = 10$)	Mean (95% CI) portion size (g)	116.0 (89.8–142.2)	73.8 (60.3–97.3)	127.3 (108.7–145.9)	206.2 (176.9–235.5)
		Mean (range) proportion of AGHE serve (%)	145.0 (44–158)	92.3 (44–106)	159.1 (86–162)	257.8 (130–260)
		Mean difference (range) vs AGHE serve (g)	36 (9.8, 62.2)	–6.2 (–19.7, 7.3)	47.3 (28.7, 65.8)	126.2 (96.9, 155.4)
Soft drink (375 mL)	Children ($n = 7$)	Mean (95% CI) portion size (g)	109.2 (44.9–173.4)	51.0 (16.5–89.5)	100.7 (38.8–173.6)	160.6 (57.5–280.8)
		Mean (range) proportion of AGHE serve (%)	136.5 (48–227)	63.7 (22–112)	125.9 (38–216)	200.7 (59–354)
		Mean difference (range) vs AGHE serve (g)	29.1 (–35.1, 93.4)	–27 (–13.4, 9.4)	26.1 (–41.2, 93.5)	89.1 (–22.4, –200.8)
	Total ($n = 17$)	Mean (95% CI) portion size (g)	113.4 (89.2–137.7)	64.4 (51.6–80.3)	116.4 (96.2–142.6)	187.4 (154.2–230.4)
		Mean (range) proportion of AGHE serve (%)	141.8 (44–227)	80.5 (22–112)	145.4 (38–216)	234.2 (59–354)
		Mean difference (range) vs AGHE serve (g)	33.4 (9.2, 57.6)	–14 (–28.3, 0.3)	39.3 (16.2, 62.5)	112 (74.1, 150.43)
Milk (250 mL)	Parents ($n = 9$)	Mean (95% CI) portion size (mL)	207.9 (116.5–299.2)	128.6 (90.5–166.9)*	231.1 (186.1–274.4)*	366.3 (267.7–471.7)*
		Mean (range) proportion of AGHE serve (%)	55.4 (87–333)	34.2 (87–212)	61.6 (182–312)	97.7 (257–600)
		Mean difference (range) vs AGHE serve (g)	–167.1 (–258, –75.8)	–246.3 (–284.5, –208.1)	–144.4 (–188.2, –100.6)	–5.3 (–107.3, 96.7)
	Children ($n = 10$)	Mean (95% CI) portion size (g)	199.0 (131.1–266.7)	91.2 (71.8–134.5)*	159.2 (107.1–244.9)*	260.8 (219.2–352.6)*
		Mean (range) proportion of AGHE serve (%)	53.1 (119–375)	24.3 (31–147)	42.5 (34–304)	69.5 (155–396)
		Mean difference (range) vs AGHE serve (g)	–176 (–243.7, –108.3)	–127.8 (–303.2, –240.5)	–199 (–267.9, –130.1)	–89 (–155.7, –22.2)
Vegetable (75 g)	Total ($n = 19$)	Mean (95% CI) portion size (g)	203.1 (55.2–251.1)	108.9 (92.9–137.3)	193.3 (161.7–241.2)	310.8 (268.9–381.2)
		Mean (range) proportion of AGHE serve (%)	54.2 (87–375)	29.3 (31–212)	51.5 (34–312)	82.8 (155–600)
		Mean difference (range) vs AGHE serve (g)	–171.9 (–219.7, –123.9)	–259.9 (–282.1, –237.7)	–173.5 (–213.3, –133.7)	–49.9 (–106.1, 6.1)
	Parents ($n = 8$)	Mean (95% CI) portion size (mL)	154.0 (77.4–230.5)	123.0 (103.6–130.1)	219.4 (185.2–238.8)	378.6 (249.6–491.1)
		Mean (range) proportion of AGHE serve (%)	61.6 (45–269)	49.2 (100–278)	87.8 (165–278)	151.4 (255–639)
		Mean difference (range) vs AGHE serve (g)	–96 (–172.5, –19.4)	–133.1 (–146.3, –119.9)	–39 (–66.3, –11.1)	120.3 (–0.4, 241)
Vegetable (75 g)	Children ($n = 10$)	Mean (95% CI) portion size (g)	210.9 (159.5–262.3)	105.4 (96.7–151.8)	171.2 (138.7–246.5)	255.5 (202.7–352.5)
		Mean (range) proportion of AGHE serve (%)	84.4 (100–293)	42.6 (19–152)	68.5 (65–284)	102.2 (102–387)
		Mean difference (range) vs AGHE serve (g)	–39.1 (–90.5, 12.2)	–125.7 (–153.3, –98.2)	–57.3 (–111.3, –3.4)	27.6 (–47.2, 102.5)
	Total ($n = 18$)	Mean (95% CI) portion size (g)	184.3 (142.6–226.1)	113.2 (106.7–134.9)	192.6 (173.2–229.2)	310.2 (256.3–358.5)
		Mean (range) proportion of AGHE serve (%)	73.7 (45–293)	45.3 (19–166)	77.0 (65–284)	124.1 (102–639)
		Mean difference (range) vs AGHE serve (g)	–65.6 (–107.4, –23.9)	–129.2 (–143.2, –115.1)	–48.8 (–76.7, –20.8)	70.8 (6.2, 135.4)
Vegetable (75 g)	Parents ($n = 9$)	Mean (95% CI) portion size (g)	116.2 (93.7–138.8)	58.2 (42.6–73.8)	120.2 (100.2–140.3)	181.7 (160.5–202.9)
		Mean (range) proportion of AGHE serve (%)	154.9 (66–148)	77.6 (38–92)	160.3 (92–163)	242.2 (152–249)
		Mean difference (range) vs AGHE serve (g)	41.2 (18.7, 63.7)	–16.7 (–32.4, –1.2)	45.2 (25.1, 65.2)	106.6 (85.4, 127.8)
	Children ($n = 8$)	Mean (95% CI) portion size (g)	91.9 (57.2–126.2)	54.6 (33.1–76.2)	106.6 (87.9–125.4)	178.4 (153.8–202.9)
		Mean (range) proportion of AGHE serve (%)	122.5 (12–148)	72.8 (12–86)	142.2 (80–137)	237.8 (118–217)
		Mean difference (range) vs AGHE serve (g)	16.8 (17.8, 51.5)	–20.4 (–41.9, 1.15)	31.6 (12.9, 50.4)	103.4 (78.8, 127.9)

Crisps (30 g)	Parents (n = 10)	Mean (95% CI) portion size (g)	32.3 (24.5–40.2)	17.6 (11.6–25.1)	31.7 (20.3–44.2)	54.1 (33.2–76.1)
		Mean (range) proportion of AGHE serve (%)	107.8 (60–156.6)	58.6 (23–100)	105.7 (37–193)	180.3 (67–373)
	Children (n = 11)	Mean difference (range) vs AGHE serve (g)	2.3 (–5.5, 10.2)	–11.5 (–10.2, –4.8)	2.2 (–9.7, 14.1)	24.6 (3.2, 46.1)
		Mean (95% CI) portion size (g)	48.6 (24.4–72.7)	144 (9.8–189)	294 (20.5–38.2)	50.3 (37.3–63.3)
		Mean (range) proportion of AGHE serve (%)	161.8 (40–140)	47.8 (13–97)	97.8 (40–187)	167 (90–277)
		Mean difference (range) vs AGHE serve (g)	18.5 (–5.5, 42.6)	–15.6 (–20.2, –11.1)	–0.6 (–9.4, 8.1)	20.2 (7.3, 33.2)
	Total (n = 21)	Mean (95% CI) portion size (g)	41.3 (28.1–54.4)	15.9 (12.6–19.9)	30.5 (24.1–37.2)	52.1 (41.4–63.1)
		Mean (range) proportion of AGHE serve (%)	137.5 (40–410)	53 (13–100)	101 (37–193)	174 (67–373)
		Mean difference (range) vs AGHE serve (g)	11.2 (–1.9, 24.4)	–13.8 (–17.4, –10.1)	0.6 (–5.8, 7.1)	22.2 (11.4, 33)

findings and individual food preferences were not accounted for. In addition, participants used their own serving vessels; however, some individuals forgot and used the food laboratory serving vessels, which may have influenced the portion served.

Conclusion

This study provides insight into the typical portion sizes that adults and children serve themselves for a variety of commonly consumed foods and drinks. There is variability between typical portion sizes of some, but not all, foods and beverages and the standard serving sizes specified in the national food selection guide.

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