

# How much should I eat? A comparison of suggested portion sizes in the UK

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## Abstract

*Objective:* To identify and compare suggested food portion sizes in UK schemes.

*Design:* The study collated and compared suggested portion sizes from selected UK schemes intended both for general advice and weight-loss advice.

*Setting:* Portion size schemes were included if they were relevant to the UK, provided actual portion size information, were intended for adults and were obtainable from the public domain in November 2010. Included schemes were from the food industry, non-governmental organisations and health-care professionals. Suggested portion sizes of foods occurring in at least one scheme for general advice and at least one scheme for weight loss were included. Own brand on-pack portion size labelling from a large UK-wide supermarket was added to represent portion size advice from UK food retailers.

*Subjects:* Not applicable.

*Results:* The suggested portion sizes in the weight-loss advice schemes were often concordant, as were the general advice schemes, except one general advice scheme from a non-governmental organisation which was more closely aligned with the portion sizes for weight loss. Overall there were substantial discrepancies between suggested portion sizes for muesli and crunchy breakfast cereals, rice, pasta and potatoes, meat, fish and pulses, whereas portion sizes for cooked vegetables, dried fruit, some breakfast cereals and cheese were broadly consistent.

*Conclusions:* There is a lack of consistency in the portion sizes communicated to the public. An independent and authoritative scheme of suggested portion sizes for all foods, with distinct recommendations for general advice and for weight-loss advice, could be of benefit.

## Keywords

Portion size

Portion size recommendations

Dietary advice

Nutrition guidelines

Portion size is defined as the amount of food an individual intends to consume at one eating occasion<sup>(1)</sup>. It is an important determinant of energy intake<sup>(2)</sup> and larger than appropriate portion sizes could increase the risk of weight gain<sup>(3)</sup>. Secular trends that favour greater availability of larger portions may be contributing to the concept of 'portion distortion', whereby larger portions are perceived as appropriate to consume<sup>(4)</sup>.

Conveying information on appropriate portion size could help facilitate appropriate intakes. Schemes for the communication of portion size messages have been described in a report by the Institute of Grocery Distribution (IGD)<sup>(1)</sup>. Portion size schemes were reported to have been developed for several purposes: analysing dietary intakes, production of menus, communication to consumers, legislation, weight loss or as an aid to achieving a healthy diet<sup>(1)</sup>. However it was reported that the public is reluctant to give much heed to portion size information on labels<sup>(5)</sup>. Other research also reported concerns about the low credibility of portion size information to consumers<sup>(6)</sup>.

A lack of clear communication of recommended portion sizes could contribute towards the inability to form appropriate concepts of suitable portion sizes. Moreover, inconsistent portion sizes could generate doubts over the validity of portion size schemes. One possible reason why portion size information may not be credible could be a lack of consistency across suggested portion sizes. Therefore, it is important to examine the consistency of suggested portion sizes communicated to the public to clarify whether there is scope for improvement in the communication of food portion sizes. The current study identified and compared suggested portion sizes from selected schemes, both for general advice and for weight-loss advice.

## Method

### Study design

Suggested portion sizes for UK schemes were collated and compared. Due to the nature of the data, statistical analysis was not appropriate.

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### **Scheme selection**

Portion size schemes were identified from the IGD report<sup>(1)</sup> and selected for inclusion if they were named schemes in, or relevant to, the UK that provided actual portion size information and were obtainable from the public domain in November 2010. Schemes were excluded if they were aimed at children, people in hospital or the elderly; if they stated frequency of portions but not portion size; and if they included suggestions only for a single food group (e.g. the Dairy Council or the National Health Service (NHS) 5-a-day scheme). As the IGD report included unnamed retailers and businesses, it was not possible to identify the source of these schemes. Therefore three large UK-wide supermarkets, as examples of retailers, were approached independently and asked to contribute their portion size information; only one supermarket provided the required information. Own brand on-pack portion size labelling on the nutrition information panel provided by this UK supermarket was used to represent portion size advice from UK food retailers. The Confederation of the Food and Drink Industries of the EU (CIAA)<sup>(7)</sup> scheme included opinions of the European Union-wide regulatory bodies for the manufacture of several food types<sup>(8–16)</sup>. As many schemes mentioned in the IGD report were not obtainable or applicable, the British Dietetic Association (BDA) and British Heart Foundation (BHF) schemes were included to improve the breadth of the review. These are two trusted UK organisations from which the public receives portion size guidance often via literature provided by health professionals. Selected schemes are shown in Table 1 and were divided into two purposes (general advice and weight-loss advice) and three categories, pertaining to the origins of the scheme (industry, health-care professionals (HCP) and non-governmental organisations (NGO)).

### **Portion size calculations**

Available portion sizes were collated and, where appropriate, allocated to a generic rather than a specific food category (e.g. carrots were allocated to the 'vegetables' category). Foods were included when they occurred in at least one scheme for each scheme purpose (i.e. in one for general advice and one for weight loss) considering all schemes except the retailer scheme. The retailer portion sizes were added for each food already chosen for analysis. For each food, the standard products were identified for inclusion (e.g. for the bread category, gluten-free bread, part-baked bread, rolls, speciality breads and fruit breads were not included) and the median and range for the portion sizes were taken, as most data did not appear to be normally distributed.

Where portion sizes were optional depending on the energy (calorie) level desired, such as those for the snacks in the BDA scheme, these were excluded. Household measures such as tablespoons were converted to gram weights by an independent observer using conversions from the dietary assessment system DINO (Diet In Nutrients Out)

developed at MRC Human Nutrition Research, based on Food Standards Agency portion sizes book<sup>(17)</sup> and direct observation as required. Where a suggested portion size was given for a general food without specific examples, a range of conversions was used and the median was taken (e.g. for the suggested portion size '1 piece of medium fruit', the median of apple, pear, orange, peach and banana weights was taken). Portion sizes that were given as weight of a raw food, when the food would be cooked before consuming, were converted into portion sizes of the cooked product<sup>(18)</sup>.

There was general inconsistency as to use of the terms 'serving' and 'portion' sizes in the starchy carbohydrate-based foods group. Often, portion sizes were specified as a serving size and a frequency. As such, the scheme intends the number of eating occasions and the serving size to be considered when following the advice. For example, the Diabetes UK scheme recommends that women aiming to achieve an energy intake of 6276 kJ/d (1500 kcal/d) should consume five servings of foods from this category daily. Thus, unless five separate meals are consumed where each time starchy carbohydrates are included, the total portion size must be more than one serving. Therefore, for schemes where two servings of starchy carbohydrates are intended to be consumed at one eating occasion (World Cancer Research Fund (WCRF), Diabetes UK, BHF, BDA, Dietitians in Obesity Management UK (DOM UK)), the serving size specified was doubled to represent the realistic portion size.

## **Results**

The suggested portion sizes are shown in Table 2. For many food types a single suggested portion size was given by many schemes. Where a suggested portion size was given as a range, the midpoint and range are shown. The retailer portion sizes are reported as a median and range unless all relevant products for a food gave the same suggested portion size.

### **Fruit and vegetables**

For the fruit and vegetable food group, the portion sizes were very consistent across NGO schemes, which, in general, were also consistent across all the HCP schemes. However, the portion sizes were often larger than the 80 g recommendation from the NHS 5-a-day scheme. Compared with the NGO schemes, the retailer portion sizes were 55% smaller for salad vegetables and 30% smaller for medium fruit. Retailer portion sizes were consistent for cooked vegetables (90 to 100 g), berries and grapes (72 to 80 g) and dried fruit (30 g), but on average 60% larger for fruit juice and 60% larger, and with more variability (80–400 g), for large fruit. The retailer portion size for large fruit was also considerably larger when comparing it with the retailer portion sizes for berries and

**Table 1** Suggested portion size schemes used, in the relevant purpose types and categories, with the target population and basis of the portion sizes in the scheme

Scheme type	Scheme category	Author	Scheme title	Target population	Basis of scheme
General advice	Industry	UK food retailer	The retailer's own product, on-pack serving sizes and nutritional information*	Consumers	<ul style="list-style-type: none"> <li>● Pack size</li> <li>● 'What is reasonable'</li> <li>● FSA Food Portion Sizes book</li> <li>● Per item</li> <li>● From industry guidance†</li> <li>● Guidelines only intended for products not already pre-portioned</li> <li>● Members mention various bases including:               <ul style="list-style-type: none"> <li>○ history of use</li> <li>○ density of product</li> <li>○ consumption data</li> <li>○ eating patterns</li> <li>○ consumption occasions</li> <li>○ energy content</li> <li>○ health benefits</li> <li>○ consumer insights</li> <li>○ company labelling practices<sup>(7)</sup></li> </ul> </li> </ul>
	Industry	CIAA	'Members portion size rationale for the Guideline Daily Amounts (GDA) labelling scheme' <sup>(7)</sup>	EU consumers	
	NGO	WCRF	Portion Pad web article 'What does a healthy portion look like?' <sup>(27)</sup>	All adults	Not available
Weight-loss advice	NGO	Diabetes UK	'Calorie controlled plan' web page <sup>(28)</sup>	Adults (with diabetes) who want to lose weight	Per portion: <ul style="list-style-type: none"> <li>● 188 kJ (45 kcal) for fruit and vegetables</li> <li>● 377 kJ (90 kcal) for starchy carbohydrates</li> <li>● 314 kJ (75 kcal) for dairy</li> <li>● 586 kJ (140 kcal) for meats and alternatives</li> <li>● 356 kJ (85 kcal) for fats and sugars<sup>(28)</sup></li> </ul>
	NGO	BHF	'So you want to lose weight...for good' publication <sup>(20)</sup>	Adults wanting to lose weight	Per portion (according to the EatWell plate food group contributions): <ul style="list-style-type: none"> <li>● 167 kJ (40 kcal) for fruit and vegetables</li> <li>● 335 kJ (80 kcal) for starchy carbohydrates</li> <li>● 377 kJ (90 kcal) for dairy</li> <li>● 586 kJ (140 kcal) for meats and alternatives</li> <li>● 167 kJ (40 kcal) for foods HFSS‡</li> </ul>
	HCP	BDA	Weight Wise – 'Eating well: your weight wise plan' web page <sup>(21)</sup>	Adults wanting to lose weight	Not available
	HCP	DOM UK	'Controlling your portions' – DOM UK Weight Management Diet sheet <sup>(22)</sup>	Adults wanting to lose weight	Per portion: <ul style="list-style-type: none"> <li>● 167 kJ (40 kcal) for fruit and vegetables</li> <li>● 335 kJ (80 kcal) for starchy carbohydrates</li> <li>● 377 kJ (90 kcal) for dairy</li> <li>● 586 kJ (140 kcal) for meat and alternatives</li> <li>● 209 kJ (50 kcal) for foods HFSS<sup>(22)</sup></li> </ul>

NGO, non-governmental organisation; HCP, health-care professional; CIAA, Confederation of the Food and Drink Industries of the EU; WCRF, World Cancer Research Fund; BHF, British Heart Foundation; BDA, British Dietetic Association; DOM UK, Dietitians in Obesity Management UK; EU, European Union; FSA, Food Standards Agency; HFSS, high in fat, sugar or salt.

\*Personal communication: UK supermarket, own brand nutrition information. Email with spread sheet of the on-pack nutrition information for the supermarket's own products.

†Personal communication: contact at a UK supermarket about portion sizes. Email describing the outline of on what the UK supermarket on-pack portion sizes are based.

‡Personal communication: Heart Matters Team, enquiry about portion sizes in the 'So you want to lose weight' publication. Email outlining on what the BHF 'So you want to lose weight...for good' scheme portion sizes are based.

**Table 2** Weight (g) of suggested portion sizes from UK schemes

Food category/food	General advice portion sizes (g)						Weight-loss advice portion sizes (g)							
	Industry						NGO						HCP	
	Retailer		CIAA		WCRF		Diabetes UK		BHF		BDA		DOM UK	
	Median or midpoint	Range	Median or midpoint	Range	Median or midpoint	Range	Median or midpoint	Range	Median or midpoint	Range	Median or midpoint	Range	Median or midpoint	
Fruit and vegetables														
Vegetables	100	50–250			90*		90*		90*		90*		90*	
Salad vegetables	42	30–125			98*		98*		98*		85*		85*	
Fruit – berries/grapes	80	80–100			72*		72*		72*		103*		65*	
Fruit – small					110*		110*		110*		138*	110–165	153*	
Fruit – medium	80	80–85			110*		110*		110*		110*		110*	
Fruit – large	200	80–400			125*		125*		125*		100*		40*	
Fruit – dried	30	14–50			30*				30*		30*		26*	
Fruit juice	250	200–330					156		156		156		156	
Starchy carbohydrates														
Cereal – muesli	50		45		105*†	90–120	90*†	60–120	60*†		90*†		90*†	
Cereal – flakes	30	30–45	35	30–40	42*†	36–48	36*†	24–48	36*†		36*†		36*†	
Cereal – crunchy	50		45		70*†	60–80	60*†	40–80	60*†		60*†		60*†	
Cereal – puffed rice	30		35	30–40	28*†	24–32	24*†	16–32	24*†		24*†		24*†	
Cereal – biscuits	38	30–38	42*						42*†					
Bread	44	23–145			80†		72*†		72*†		72*†		72*†	
Rice	208	125–208			200*†	160–240	160*†		160*†		160*†		160*†	
Pasta	167	114–380	200	180–220	185*†	148–222	148*†		222*†		222*†		148*†	
Potatoes	125	50–250			240*†		160*†		160*†		160*†		160*†	
Meat, fish, legumes, nuts and seeds														
Meat	47	8–200	100		80		73	60–85	75	60–90	75	60–90	50	
Poultry	100	8–210	100		80		73	60–85	75	60–90	75	60–90	50	
Fish – oily	75	16–171			80		130	120–140	140		75	60–90	50	
Fish – white	124	101–157			150		130	120–140	150		150		125	
Pulses	128	80–210			150*		53*		120*		120*		150*	
Nuts	25	25–30	30		50*		50*		50*				40*	
Seeds	25	25–30			24*								40*	
Dairy														
Milk	200				259	207–310	197		207		207		207	
Yoghurt/fromage frais	150	100–150			162		135		150		100*		125	
Cheese	30	13–33			30				30		30		25	
Fats														
Oil	15				3*		6*		3*		3*		3*	
Butter	10				5*		10*		5*		5*		5*	
Fat spreads	10		10		5*		10*		5*		5*		5*	
Foods HFSS														
Biscuits	17	5–28			10*						10*		10*	
Ice cream	53	40–69	50				60*							
			(2 scoops)				(1 scoop)							
Crisps/savoury snacks	25	8–50	30				20*							
Chocolate	25	16–40	25				9*							

NGO, non-governmental organisation; HCP, health-care professional; CIAA, Confederation of the Food and Drink Industries of the EU; WCRF, World Cancer Research Fund; BHF, British Heart Foundation; BDA, British Dietetic Association; DOM UK: Dietitians in Obesity Management UK; HFSS, high in fat, sugar or salt.

\*Converted from a household measure or number of items into a weight.

†Starchy carbohydrate food portion size given in scheme was doubled to give true portion size.

grapes, and medium fruit. The differences that existed in the industry portion sizes may indicate that the NHS 5-a-day message may not always be followed when communicating portion sizes through the products and packaging produced. This is of concern as consumers may believe they are consuming one portion of some fruits or vegetables produced by industry, but in fact they may be under- or overconsuming these foods. Overconsumption of fruit juice is of particular concern due to the high sugar content and lack of fibre highlighted by the 5-a-day message limiting a portion to 150 ml, yet the retailer suggested a 250 ml portion.

In comparison with the NGO schemes, the BDA and DOM UK portion sizes were largely consistent for cooked vegetables, medium fruit and dried fruit, but not for berries and grapes (72 g for NGO *v.* 103 g for BDA and 65 g for DOM UK), small fruit (110 g for NGO *v.* 138 g for BDA and 153 g for DOM UK) and large fruit (125 g for NGO *v.* 100 g for BDA and 40 g for DOM UK). These differences were likely to have occurred as these schemes gave the portion sizes of these food categories with specific examples, whereas the others (WCRF, Diabetes UK and BHF) gave general portion sizes and thus on conversion into weights the average of several examples was given. Moreover, BDA and DOM UK stated that a portion of small fruits was two to three pieces, whereas it was two pieces for the NGO schemes; the reason for this difference is unclear.

### **Breakfast cereals**

Breakfast cereal portion sizes were very similar between the two industry schemes, varying by a maximum of 5 g within each type of cereal. Across the NGO and HCP schemes, portion sizes continued to be consistent for flaky breakfast cereals, but they were slightly larger than industry (30 to 35 g for industry and 36 to 42 g for NGO and HCP), and for puffed rice breakfast cereals they were slightly smaller (30 to 35 g for industry and 24 to 28 g for NGO and HCP). Biscuit-type breakfast cereals portion sizes were also similar between industry and the BHF. However, for muesli, NGO and HCP portion sizes (60 to 105 g) were between 20% and, exceptionally, 133% larger than industry portions (45 to 50 g). Moreover, for crunchy cereals, NGO and HCP portions were between 20 and 56% larger than industry portions. The discrepancies in muesli and crunchy cereal portion sizes could be due to the NGO and HCP schemes providing a general portion size in household measures for all cereal types as this approach does not account for the varying densities of breakfast cereals. The BHF muesli portion size was closer to the industry portion size as the BHF gave separate portion sizes for muesli and flaky or puffed rice breakfast cereals. It could also be argued that the schemes did not intend the serving sizes of cereals to be doubled; indeed, they intend the serving size to be used in conjunction with the recommended frequency of daily servings. However, this would mean although denser

breakfast cereals would have smaller portions more in line with industry portions, the portions of flaky and puffed rice cereals would be considerably smaller than the on-pack and industry regulatory body suggestions for a portion.

### **Bread, rice, pasta and potatoes**

There was considerable disagreement across schemes with regard to the portion sizes of bread, rice, pasta and potatoes. The WCRF portion sizes stand out as they were often larger than those in the other general advice schemes (i.e. for bread and potatoes) and were consistently larger than those in the weight-loss advice schemes. This may reflect the amount that would need to be consumed to meet energy requirements if 'discretionary' items such as biscuits, confectionery and sugar-sweetened beverages were limited in the diet (and portion sizes for many of those and similar foods are not provided by WCRF).

Although the retailer portion sizes were highly variable for bread, the median portion size was 39 to 45% smaller compared with the NGO and HCP schemes. The incongruence with industry, where the on-pack suggested serving was likely to be one slice of bread (as on-pack nutrition information is often given per unit of food where applicable), was due to the doubling of the NGO and HCP servings of bread to give one 'portion' of two slices. However, this more realistically reflects common consumption of bread at one eating occasion, e.g. two slices of bread to make a sandwich (the mean weight eaten of bread from the National Diet and Nutrition Survey in adults conducted in year 2000/2001 was 73.3 g, which would be approximately two slices). The inconsistency between our conversion of 36 g, the WCRF suggesting that one slice was 40 g and the industry median weight of a slice of bread being 44 g may indicate the standard conversions (based on data from 2002<sup>(17)</sup>) are outdated and that currently an average commercially available slice of bread is larger than is presumed.

A portion size for rice of 160 g was consistent across most of the weight loss advice schemes. However, WCRF stands out with a portion size of 200 g, although this is similar to the retailer median rice portion of 208 g. The retailer and WCRF portion sizes for pasta were also quite similar. However, the CIAA portion size range (180–220 g) encompasses the WCRF portion but not the retailer median portion size or the weight-loss advice portion sizes (148 g for Diabetes UK and DOM UK and 222 g for BHF and BDA). The consistency across rice portion sizes in general advice and weight-loss advice schemes, separately, is in contrast to the inconsistency across the pasta portion sizes.

For potatoes, portion sizes were consistent (160 g) among the weight-loss advice schemes, but were larger than the median potato portion size in the retailer scheme and smaller than the WCRF potato portion size (240 g). The variability in the portion sizes between schemes, and within the retailer scheme, for rice, pasta and potatoes, suggests that appropriate portion sizes still need to be defined.

### **Meat and fish**

The portion sizes for meat and poultry were similar across NGO and HCP schemes except for DOM UK which was 34% smaller on average. CIAA considers a portion to be approximately 33% larger than the majority of the other schemes. The retailer median portion sizes for meat and poultry were variable; compared with the NGO and HCP schemes the median meat portion size was much smaller at 47 g, while for poultry it was slightly larger at 100 g. The Department of Health recommends that a portion of red meat should be 70 g (once daily) due to the increased risk of bowel cancer in those who consume more than 90 g of red or processed meat daily<sup>(19)</sup>. This indicates that schemes need to reduce their suggested meat portions to be in line with this recent government recommendation. It is notable that the CIAA gave a recommendation of 100 g for meat as a meal component, which was used in the present study, but an additional recommendation of 25 g for meat as a sandwich filler was given in the scheme<sup>(14)</sup>. Therefore, although the CIAA portion of meat as a meal component is larger than for other schemes, this scheme recognises the need to supply different portion size suggestions for different purposes. The inclusion of suggested portion sizes of meat for purposes such as for sandwiches (e.g. sliced ham) most likely explains why we found that the retailer median on-pack suggested portion size for meat to be considerably smaller than the others. However, the retailer portion size range extended to 200 g which is more than double the NGO and HCP recommendations. The suggested portion size for oily fish was variable across the schemes (75 to 140 g), but was more consistent for white fish (124 to 150 g).

### **Legumes, nuts and seeds**

Across the schemes, the portion size of pulses was reasonably consistent, varying between approximately 120 g (retailer, BHF and BDA) and 150 g (WCRF and DOM UK). However, Diabetes UK gave a much smaller portion of 53 g. This may be related to the conversion from household measures to absolute weights, which may have resulted in a smaller than intended portion. There was agreement among the NGO schemes that a portion of nuts was 50 g but industry schemes and DOM UK gave portion sizes 40 to 50% and 20% smaller, respectively, than the NGO. For seeds, the retailer and WCRF were in agreement on the portion size (24 to 25 g); however, DOM UK gave a portion 60% larger.

### **Dairy**

The suggested portion size for milk was very consistent across schemes (197–200 g), except for the larger portion suggested by WCRF (259 g). Yoghurt or fromage frais portion sizes varied between schemes (100 to 162 g), suggesting that the appropriate portion size for this food is still equivocal. The cheese portion sizes were congruent (30 g), except for DOM UK which gave a 17% smaller portion.

### **Oils and fats**

The NGO and HCP schemes, except for Diabetes UK, suggested portion sizes of oils and fats that were considerably smaller (3 g for oil and 5 g for butter and fat spreads) than industry portions (15 g for oil (400% larger) and 10 g for butter and fat spreads (100% larger)). The smaller NGO and HCP suggestions for fats and oils portion sizes indicate that it may be important for industry to readdress not only the on-pack labelling and regulatory guidance for this group of foods, but also the widely available individual 10 g portions of butter and fat spreads. However, it is surprising that, despite being aimed at weight loss, the Diabetes UK suggested portions of these foods were twice as large compared with the other NGO and HCP schemes (6 g for oil and 10 g for butter and fat spreads).

### **Foods high in fat, sugar or salt**

When considering the foods high in fat, sugar or salt (HFSS), it is noteworthy that the biscuits, crisps and chocolate portion sizes commonly available to consumers, and suggested by the industry regulatory body, appeared to be larger than the suggested portion sizes from NGO and HCP (17 g *v.* 10 g for biscuits; 25 to 30 g *v.* 20 g for crisps and snacks; 25 g *v.* 9 g for chocolate).

For ice cream initially it appeared that suggested portion sizes from industry and Diabetes UK were in agreement. However, there is a discrepancy between the conversions of one scoop, as the suggested number of scoops was two for the CIAA and one for Diabetes UK. The conversion used in DINO is 60 g<sup>(17)</sup>, whereas the conversion used by the CIAA is 25 g<sup>(11)</sup>. Therefore one of the conversions could be incorrect which could perhaps be due to variations in the density of ice creams. However, as consumers prefer to follow guidelines based on household measures<sup>(5)</sup>, the inconsistency in the number of recommended scoops is of concern.

Several schemes (WCRF, BHF, BDA and DOM UK) did not give recommendations for three of the foods HFSS. This could suggest that either the recommendation was not to consume any of these foods, or that the schemes were unable to suggest a portion size as a general recommendation. However, the most likely explanation is that these schemes consider these foods as optional snacks that are picked by the individual based on the desired total daily energy intake. Indeed, some of these schemes (BHF, BDA and DOM UK) listed different portion sizes of foods HFSS and the corresponding energy content<sup>(20–22)</sup>.

### **Discussion**

As one would expect, within the two industry schemes designed to give general advice, portion sizes were fairly consistent. Likewise, there was often consistency in schemes intended for weight-loss advice. However, the

WCRF scheme, intended for general advice, was more consistent with the weight-loss schemes than the general advice schemes. Inconsistency across portion size messages between schemes intended for the same purpose (such as general advice or weight-loss advice) could exacerbate consumer concerns<sup>(6)</sup> about the credibility of portion size information. Similarities and differences between portion sizes could be explained by the differences in the rationale used to develop each scheme (Table 1).

The portion sizes suggested by DOM UK were often incongruent with the other NGO and HCP schemes intended for weight loss. They suggested smaller portions of cheese, meat, fish and nuts, but slightly larger portions of small fruit and pulses, shifting the overall balance of the diet away from protein and fat and towards carbohydrate-rich foods, perhaps to encourage closer adherence to dietary reference values for macronutrients. However it is not clear if these recommendations are appropriate for weight loss.

It is noteworthy that the CIAA (an industry regulatory body) did not specify portion sizes for many of the core food groups (except meat and poultry) focusing instead on 'processed' foods. However, often individual groups will have portion sizes for these food groups, e.g. The Dairy Council<sup>(23)</sup> or the NHS 5-a-day scheme<sup>(24)</sup>. This may explain the consistency between portion sizes suggested by the retailer and the NGO and HCP schemes for medium fruit, cooked vegetables, dried fruit, milk and cheese. However, for some foods, even if the industry median portion was consistent with suggested portion sizes from other schemes, often the range of suggested portion sizes was highly variable (e.g. pulses). This could lead to consumer confusion and subsequent distrust in on-pack portion size messages.

It is notable that sugar-sweetened beverages are not included in this comparison. The CIAA was the only scheme to give a suggested portion size for non-alcoholic beverages (250 ml is one portion in a multi-portion pack). However, given the association between sugar-sweetened beverages and the risk of weight gain<sup>(25)</sup>, portion size advice for these products would be particularly helpful.

The sometimes marked difference between industry portion sizes and the recommendations of the NGO or HCP schemes, particularly for foods HFSS, suggests that the recommended portion sizes are not always the size of the commercially available pre-packaged units. This highlights the importance in considering the portion sizes of the products available to consumers when communicating recommendations for portion sizes.

### Limitations

The current study has several limitations. First, not all foods were examined and there may be some foods such as other foods HFSS that would be important to consider due to their contribution to energy intake and subsequent

importance in weight maintenance and weight loss. Second, only UK schemes have been considered, but the UK public may be exposed to some other overseas schemes (e.g. the US Department of Agriculture's My Pyramid scheme<sup>(26)</sup>) which may increase variability even further. Third, only schemes providing suggested portion sizes for adults were included in the current study. However, furthering this research to examine the consistency of portion sizes suggested in schemes intended for children would be warranted. Fourth, only one retailer was used as a representative of a business portion size scheme. Further retailer schemes would add more information on portion sizes commercially available and communicated by businesses. Finally, comparisons were made after objective conversions of household measures into weights. As there was not always sufficient information given in the schemes, the conversions may not always be consistent with the schemes' intentions. Moreover, conversion into weights is not necessarily how a member of the public would interpret the scheme and there is likely to be considerable inter-individual variability in portions served even when apparently adhering to the guidelines. Concluding whether the communication of portion sizes of some foods is consistent is difficult as the schemes sometimes gave insufficient information or DINO lacked exact conversions and the closest available conversion had to be used (i.e. only a heaped tablespoon conversion was available for nuts). Moreover, as previously found in the IGD report<sup>(1)</sup>, the examination of the schemes in the present study highlighted the inconsistency and lack of clarity in the use of the terms 'portion size' and 'serving size'. In addition, schemes often described portion sizes along with frequencies of consumption, which, as this caused a lack of ease of interpretation in the present study, could also lead to errors in interpretation by members of the public.

### Conclusions

The present comparison has revealed the substantial discrepancies between recommended portion sizes in different schemes and that greater consistency in the portion sizes communicated to the public is needed. Advice to consumers could be improved if schemes were clearer as to the exact suggested portion size intended (e.g. a heaped or level tablespoon). These measures could help to improve the credibility of the portion size advice. Moreover, distinguishing between schemes intended for weight loss and those giving general advice would also help to address some of the public's confusion around portion size recommendations<sup>(6)</sup>. The variability within a food type in the industry on-pack suggested portion sizes may contribute to distrust in industry portion size advice and the inability to form a concept of an appropriate portion. As current NGO and HCP schemes

may only be accessed by health-conscious members of the public or those wishing to lose weight, industry schemes may have a greater impact as exposure is across all consumers. There may be benefits of mass communication of an independent and authoritative scheme on suggested portion sizes for all foods, with distinct recommendations for general advice and for weight-loss advice.

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