Is misreporting of dietary intake by weighed food records or 24-hour recalls food specific?

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Short Title

Is misreporting food specific?

Keywords

Dietary assessment, food groups, nutritional epidemiology, food diaries

Abstract

Background: Healthy eating advice is informed, in part, by dietary surveys that rely on self-reported data. Misreporting of food intake may distort relationships between diet and health outcomes. This study directly quantified the food groups that were under-reported or over-reported in common dietary assessment techniques.

Methods: Food and drink consumption of 59 adults, with ad lib access to a range of familiar foods, was objectively and covertly measured by investigators, and validated against independent measures of energy balance, while participants were resident in the Human Nutrition Unit of the Rowett Institute. Participants self-reported their diets using weighed dietary records (WDR) and multiple pass 24-hr recalls over two periods of 3-d using a cross-over design. Foods and drinks were aggregated into 41 food groups.

Results: The mean daily weight of food and drinks reported was significantly lower than actually consumed; 3.3kg ($p = 0.004$, 95% confidence interval (CI) = 3.07-3.55kg) and 3.0kg ($p < 0.001$, CI = 2.80-3.15kg) for the WDR and 24-hr recall respectively, compared to 3.6kg for the objective measure. Reported intakes were significantly lower than the objective measure for four and eight food groups (WDR and 24hr recall respectively), and not significantly different for the remaining food groups.

Conclusions: Although under-reporting was greater for some food groups than for others, “healthy” foods were not over-reported and “unhealthy” foods were not consistently under-reported. A better understanding of which foods tend to be misreported could lead to improvements in the methods of self-reported dietary intakes.

Introduction

Diet is frequently measured in large scale surveys using 24-hr recalls or food frequency questionnaires, or in smaller studies using the weighed, or unweighed, food diary method. All of these methods rely on self-reported information from participants, which are prone to misreporting and may not be representative of the habitual diet, or even an accurate record of the diet over the measurement period (1,2). Findings from studies using self-reported dietary records contribute to the development of healthy eating guidelines, and if these data are undependable apparent relationships between diet and health outcomes may be distorted (3). The nature of dietary misreporting makes estimating its extent and implications difficult as most, if not all, study participants misreport or change their diet to varying degrees (4). For an assessment of dietary misreporting an independent measure of diet, or a proxy measure of dietary intake such as urinary nitrogen excretion as a biomarker of protein intake (5) is needed. Such methods give little information on the foods that are misreported, other than, perhaps, those with high concentrations of the relevant recovery biomarker.

A recent development is dietary pattern analysis where emphasis is on describing the frequency of consumption, variety, and the combination of foods that are normally consumed in addition to the amounts (6), suggesting that it is important to identify the types of foods and drinks that are more likely to be misreported. A number of studies give reported intakes of food groups by low energy reporters and by those with more plausible reported energy intakes (7-9). Evidence across a number of studies suggests that low energy reporters tend to misreport food groups in line with what is perceived as a “healthy” diet (10,11). Reported consumption of “unhealthy” foods (e.g. cakes and biscuits) tend to be lower for low energy reporters than for others (as expected given lower reported energy intakes), but reported consumption of “healthier” foods (e.g. salads and vegetables) can be similar, or even higher (10,12-14). In contrast others showed significant differences in the misreporting of all food groups, regardless of whether they might be considered “healthy” or “unhealthy” (9,15-17). Some of these discrepancies were large, for example Krebs-Smith et al. (16)

found that only 10% of low energy reporters reported pie or cake consumption, whilst 30% of plausible energy reporters did.

The above studies did not objectively measure food intake, and differences in the amounts of foods consumed could be because low energy reporters simply eat less of some foods, at least while recording their food intakes, or change their diet more when they are aware that their diet is being monitored. Few studies have devised methods to objectively measure misreporting with regards to food intake, as observation and accurate recording is not always practical (18,19). Such objective data were collected under laboratory conditions, albeit under conditions that were as close to free-living as practicable, to measure the difference between what people report eating, and what they really consume, in the context of energy balance (4). Participants ate less, to the extent that they reduced their energy intake by 5%, when asked to record food consumption (the observation (4) or reactivity (20) effect). Reported energy intake was an additional 5.1% lower than actual energy intake when participants recorded their intakes using a weighed dietary record, and an additional 10.1% lower when completing 24-hr recalls. The aim of the present study was to quantify the food groups that were under-reported or over-reported when participants reported their dietary intakes using two common tools; a multiple pass 24-hr recall and a weighed food diary. In addition the study aimed to identify the food groups that appeared to be forgotten by participants during the 24-hr recalls.

Subjects and methods

Study Design

Participants for the study were recruited from the Aberdeenshire area by press releases, newspaper advertisements and posters. Participants of previous studies at the Rowett Institute were also invited to take part. Smokers and potential participants with medical conditions, eating disorders or taking medication known to affect appetite were excluded. The study aimed to recruit sixty participants, five males and five females in each combination of three age groups (20 - 35.9 years, 36 - 50.9

years and 51 - 66 years) and two BMI categories (<25 and >25 kg/m^2). A gratuity (£200) was given to compensate participants for their time.

The study design, validation and methods have been described in full previously (4). In summary, 59 healthy participants (table 1) were resident in the Human Nutrition Unit of the Rowett Institute for 12 d, which involved two 3 d overt phases (during which participants reported their food intake) and two 3 d covert phases (during which they did not) in a randomised cross-over design. All participants completed a 7-day diet history before the study, and shopping till receipts were collected, which were used to formulate individual lists of foods and beverages usually consumed. Each participant was provided with their own larder, fridge, freezer and individual kettle, and had ad libitum access to a variety of these familiar foods. All food items were weighed by research staff to the nearest 0·1 g on digital scales (Soehnle model 820; Soehnle-Waagen GmbH or Ravencourt model 333; Ravencourt) including the weight of packaging before they were placed into each subject's personal kitchen. Participants were instructed to consume only their own food, and drink only their individual bottled water that was provided for drinking, and for making tea and coffee, to allow an estimate of water consumption. Each participant was instructed not to throw any waste away including packaging of food items, peelings and leftovers from meals. Every kitchen contained a special bin for all waste and packaging. Video cameras continually monitored feeding behaviour and compliance to the protocol. All parts of the HNU, with the exception of the subjects' private rooms and bathroom facilities, contained small discrete video cameras, which were used to cross check, item by item, the validity of the food intakes. Participants were not allowed to take food into their private rooms or bathroom. Foods and beverages consumed by participants were covertly measured over the whole 12 d and quantified by trained staff as food disappearance from each participants' personal kitchen, which provided the objective measure known as covert weigh back (CWB). Participants were unaware of the CWB procedures.

The self-reported measures, which provided the subjective measures, were weighed dietary records (WDRs) and multiple-pass 24-hr recalls, which used standard methods (21,22). A trained member of staff carried out six 24-hr recalls based on the multiple-pass design (21,22). Each 24-hr recall was conducted the day after a WDR was completed.

Data used from these analyses came from the two 3 d periods when participants were reporting their dietary intakes. The CWB was the reference method of true food and drink intakes.

Food intake analysis

Dietary data consisted of the weights of foods consumed (CWB) and reported (WDR and 24-hr recall) for each participant. Foods were aggregated into 41 food groups (supplementary online material) based on those used in the National Diet and Nutrition Surveys (23). Foods, and their weights, were harmonized across the three assessment methods where necessary. For example, foods recorded in the CWB were as raw, or uncooked, weights, whereas those reported in the 24-hr recall were as consumed. Weights from the WDR were a mixture of the raw and the cooked. Any foods reported as raw weights were converted to cooked weights using weight change information from food composition tables (24) to minimise differences across the methods resulting from food preparation and cooking. Food waste from preparation and “left-overs” had previously been accounted for in the CWB. Composite dishes (n=25) that had been prepared from ingredients by participants, and that had been recorded in the WDR or 24-hr recall as the weight of the complete dish rather than listing all the ingredients and weights separately, such as “lasagne” or “scrambled eggs”, were disaggregated into their separate ingredients. Representative recipes, and food preparation information, were taken from food composition tables (24), located online (see supplementary online material), or from the food packets when not provided by participants.

A “misreporting error” was calculated for the difference between the reported value (WDR or 24-hr recall) and the reference method as a percentage of the reference method, e.g. (WDR – CWB) / CWB *100.

To estimate the extent to which foods were forgotten by participants during the recalls, the proportion of foods in the CWB that were also in the 24-hr recall was calculated as the proportion of true intake recalled. Foods and drinks recorded in the CWB were cross-checked against the 24-hr recall records to identify those that had been recalled and those that had not. The percentage of the weight of each food that had been consumed (CWB), which was subsequently remembered during the 24-hr recall was calculated for each food group. For example, if a participant had eaten 100g of banana (as recorded in the CWB) on a particular day, and had reported any amount of banana on the same day when completing the 24-hr recall, it was assumed that all of the 100g had been remembered.

Statistical analyses

Friedman tests (25,26) were used to test for differences in weights across the three assessment measures, as the data were skewed and the concurrent assessment measures were paired. Statistical tests were two-sided. A Bonferroni correction for multiple comparisons was applied, and subsequently Wilcoxon signed rank tests were performed to test for differences between pairs of assessment measures.

Ethics

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human participants were approved by the Joint Ethical Committee of the Grampian Health Board and the University of Aberdeen. Written informed consent was obtained from all participants. The real purpose of the study was, necessarily, not explained to the participants and they were informed that it was to examine the relationships between diet and lifestyle.

Results

Characteristics of the participants are provided in table 1. One participant completed only five days of the WDR, one only five days 24hr recalls, and one only three days 24hr recalls. The remainder had complete dietary intake records for both methods. The mean daily weights of food and drinks reported by participants were significantly lower than the reference method (3.3kg, p=0.004, 95% confidence interval (CI)=3.07-3.55kg and 3.0kg, p<0.001, CI=2.80-3.15kg for the WDR and 24-hr recall respectively, compared to 3.6kg for the CWB). There were no significant differences in the misreporting error for the WDR or 24-hr recall between the males and females (p=0.657 and p=0.414 respectively), or between lean (BMI < 25 kg/m^2) and overweight (BMI > 25 kg/m^2) participants (p=0.770 and p=0.261 respectively). Results are therefore presented for all participants combined.

Table 2 gives the median values and interquartile ranges for the 41 different food groups that were reported using the two dietary assessment measures and the reference CWB method, and the mean misreporting error. For 28 of the food groups the mean misreporting error was negative indicating that these food groups tended to be under-reported, although differences in the amounts across the three methods were not always statistically significant after adjustment for multiple comparisons. The amounts of four food groups (milk & milk-based drinks & cream, fruit, water & drinks and sandwiches & bread) reported by participants in both the WDR and 24-hr recall were significantly lower than the CWB. The amounts of four other food groups (fruit juices, breakfast cereals, meat and biscuits) reported in the WDR was similar to the CWB, while the 24-hr recall was significantly lower than both the CWB. There were no statistically significant differences across the three methods for the remaining food groups.

There was no evidence of “healthier” foods being over-reported or, with the exception of the biscuits food group, of “unhealthy” foods being specifically under-reported.

On average, 85.3% of the weight of foods and drinks in the CWB were recalled when participants completed the 24-hr recalls. The individual values for each of the food groups are provided in table

2. Values for all except three of the food groups (oil, herbs and spices, and salt) were above 66% of the CWB, and for 32 of the food groups it was 80% or above.

There was only a moderate relationship between the proportion of the true intake that was recalled (i.e. foods that were recorded in the CWB that were mentioned by participants when completing the 24-hr recall) and the reporting error (24-hr recall / CWB) (R^2=0.202, p=0.003).

Discussion

When self-reporting their intakes of foods and drinks using two common dietary assessment techniques, weighed dietary records and multiple pass 24-hr recalls, participants in this study generally under-reported the amounts that they actually consumed. Reported intakes were significantly lower than the objective measure for four and eight of the 41 food groups (WDR and 24-hr recalls respectively), and not significantly different for the remaining food groups. Reported intakes of milk & milk based drinks & creams, fruit, water & drinks, and sandwiches & breads were lower by the WDR and 24-hr recall methods. Fruit juices, breakfast cereals, meat and biscuits were lower by the 24-hr recall method. With the exception of biscuits, foods and drinks that might be considered “unhealthy” did not appear to be under-reported more than any other foods or drinks. Similarly, foods and drinks that might be considered “healthy” did not appear to be over-reported more than any other foods or drinks. Both the fruit, and fruit juices food groups were under-reported.

Total reported intakes were significantly lower for the WDR, and lower still for the 24-hr recall, compared to the reference method, resulting in a difference in energy intakes of -5.1% for the WDR and -10.1% for the 24-hr recall (4). In a review of misreporting of energy intakes, Poslusna et al. (27) found a median difference of energy intake reporting of -18.0% for 24-recalls that were measured over 2-d (2 studies) and -13.4% for 3-d or 7-d weighed food records (5 studies). In all but one of these studies low energy reporting was assessed by comparing reported energy intake to energy expenditure measured using doubly labelled water. The few studies that have compared reported to objectively measured intakes have used 24-hr recalls and measured intake over one day (28-31), In these studies, mean reported energy intake from the 24-hr recalls, compared to the reference method, was -12.5% (33 females) (28), not significantly different (42 males) (29), +7.6% (79 males) and +10.3% (71 females) (30) and +8.3% (49 females) (31). Thus, the degree of low energy reporting from the 24-hr recall method in the current study appears similar to that reported in free-living studies (27).

The extent to which foods were forgotten by participants during the 24-hr recalls was also estimated in the current study. The more that foods were recalled (mentioned by participants when completing the 24-hr recall) the smaller was the under-reporting of the food group, suggesting that the under-reporting error associated with the 24-hr recall comes mainly from participants forgetting to report foods eaten rather than from the weights and portion sizes described.

Mela & Aaron (32) asked people who had never completed a dietary assessment which foods they would expect to eat more of, or less of, if asked to record their food intakes. Forty-three percent of people indicated that they would eat more fruits and vegetables, and 31% indicated that they would reduce their consumption of cakes, pastries and confectionery. Similarly, 46% of participants who had completed a 7-d weighed food record admitted altering their diet because of embarrassment about recording specific foods, inconvenience of the method, or other reasons (33). Thus, participants are aware that they change their diet when recording it, known as the observation effect (4) or reactivity effect in the US (20), which was not assessed in the current study. Participants then fail to record all of the foods and drinks that they do consume from their modified diets (4).

Previous studies have identified that consumption of cakes, biscuits, confectionary, chips, sweets and high fat products, were generally lower for low energy reporters (10,12,14) and consumption of vegetables, fruits and salads were higher (12,13). However, Bingham et al. (15) found reporting of vegetables did not differ between those defined as “plausible” and “misreporters”, and Lafay et al. (17) found that fruits and green vegetables were under-reported to a similar degree between the groups. Others have reported a mixture of patterns, where low energy reporters were less likely to report an array of food groups, including fruits, vegetables, cakes and pie (9,16). Yet, as under-reporters were identified in these studies using ratios of energy intake to basal metabolic rate (34), which cannot detect misreporting only improbably low energy intakes, or low urinary nitrogen excretion, the reported energy intakes will include both the observation and recording effects. Difference between low energy reporters and plausible energy reporters in the amounts of foods reported may be, at least in part, because of an accurate report of an atypical diet rather than deliberately or inadvertently failing to record foods.

In the direct observation study of Poppitt et al. (28), under-reporting was mainly of snack foods, but this appeared to be more related to the eating occasion (snacks rather than main meals) rather than the types of food items per se, as “healthy” snacks (such as fruit and low-fat yogurt) were misreported just as much as were “unhealthy” snacks (such as confectionery and potato crisps). The current study found that common snack foods were either significantly lower than the CWB from the self-reported measures (biscuits) or were not significantly different (potato chips and potato products, savoury snacks, confectionery, and cakes, etc.).

Generally, reported intakes of food groups were similar to the CWB, or were significantly lower. Large differences were apparent for salt, although differences were not significant after applying the conservative Bonferroni adjustment for multiple comparisons. Salt is generally an addition when cooking, or added to meals at the table, and along with condiments is often forgotten when self-reported and is difficult to weigh accurately (18,35); self-reported measures of salt intake underestimated mean daily intake by 25% to 30% compared to total urine sodium excretion (35).

There are limitations and features of the study design that need to be considered when interpreting the results. The residential nature of the study that allowed misreporting to be covertly measured also reduced the external validity of the findings. Although conditions were as close to free-living as practicable, participants were free of the general distractions of work and home life during the study, and may have had more time and attention to complete the diet records. The discrepancy between actual and reported food intake tends to increase the less controlled the environment participants are in (e.g. at home compared to in the HNU) (36). The study design did not allow any dining out at restaurants, where the weighing of food for the WDR method is less convenient (37) and possibly less accurate than preparing and eating food at home. Each participant prepared their own food and would have been more aware of the ingredients and amounts than if it was prepared by others, as might be the case at home. Participants recorded their diet for two separate periods of three days, and misreporting may have increased with a longer recording period, such as seven days as is often used in dietary surveys. The little available evidence suggests that reported energy intakes decrease slightly over the recording period (38). There may have been some waste of water and hot drinks (tea and coffee) that was not accounted for during the CWB measurements, such as water remaining in the kettle or in mugs after making a hot drink, which was disposed down the sink by the participant before it could be weighed by the investigators. The study was conducted on a small number of participants who were prepared to spend two-weeks in a residential facility and were presumably well motivated given the duration and intensity of the study; this reduces the relevance of the findings to free-living situations.

Future research within the field should focus on “real world” settings using measures that can objectively measure food intake within a number of contexts. Use of automated wearable cameras that passively capture such data by recording eating behaviours have highlighted that snack foods, beverages and condiments were commonly misreported (18). The recorded images allowed consumption to be viewed from the participant’s point of view and such technology could be used in the future, with a larger sample size, to assess the misreporting of food groups outside of the boundaries of a laboratory setting.

Although there appeared to be no statistical difference in the misreporting error between males and females, or between lean and overweight participants, the sample size of 59 was probably not large enough to explore associations between misreporting of food groups and participant characteristics. Other studies have suggested that females, older adults, and people with higher BMIs are more likely to misreport (39).

Against these limitations, the covert weigh back assessment method was developed and validated using the principles of energy balance as a “gold standard”, allowing an accurate measurement of ad libitum dietary intake of foods typical of participants’ normal diet, within a laboratory environment (4).

In conclusion, this study found that the overall weights of food and drinks reported by participants using weighed dietary records and 24-hr recalls were significantly lower than the objective measure of actual consumption. Although under-reporting was greater for some food groups than for others, it was generally the case that “healthy” foods were not over-reported and “unhealthy” foods were not consistently under-reported. The under-reporting error associated with the 24-hr recalls appeared to come mainly from participants forgetting foods rather than inaccurate weights and portion sizes described. A better understanding of which foods tend to be misreported could lead to improvements in the methods of self-reported dietary intakes.

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Conflict of Interest

None of the authors had a potential conflict of interest.

Table 1. Baseline characteristics of the study participants by: sex, age and BMI groups. Values are mean (SD).

Sex	Age (years)	BMI category	n	Age (years)	Height (m)	Weight (kg)	BMI (kg/m2)
Female	20 - 35	20 - 25	5	24.8 (2.6)	1.71 (0.04)	65.8 (5.1)	22.5 (1.1)
Female	20 - 35	> 25	4	24.8 (4.0)	1.62 (0.03)	71.9 (6.3)	27.3 (1.8)
Female	36 - 50	20 - 25	5	40.8 (4.4)	1.67 (0.07)	61.9 (8.2)	22.2 (2.7)
Female	36 - 50	> 25	5	45.2 (3.7)	1.64 (0.09)	76.8 (11.7)	28.6 (2.6)
Female	51 - 65	20 - 25	6	57.7 (5.3)	1.64 (0.06)	63.5 (7.4)	23.5 (1.4)
Female	51 - 65	> 25	4	58.0 (6.5)	1.62 (0.08)	78.9 (12.9)	29.7 (2.2)
Male	20 - 35	20 - 25	4	23.8 (3.0)	1.79 (0.07)	75.8 (8.1)	23.6 (0.5)
Male	20 - 35	> 25	5	29.8 (4.0)	1.77 (0.05)	88.7 (12.2)	28.2 (2.9)
Male	36 - 50	20 - 25	4	42.8 (4.8)	1.73 (0.06)	65.7 (6.2)	22.1 (0.2)
Male	36 - 50	> 25	7	42.6 (5.1)	1.77 (0.04)	93.9 (15.2)	29.9 (3.5)
Male	51 - 65	20 - 25	3	52.3 (1.5)	1.78 (0.06)	72.9 (12.4)	23.0 (2.6)
Male	51 - 65	> 25	7	59.7 (3.8)	1.75 (0.05)	87.5 (8.9)	28.6 (2.8)

Table 2: Summary of the medians and inter-quartile ranges for the assessment measures, the proportion of the foods consumed that were reported by participants in the 24-hr recalls along with the statistical significance of differences across the three measures. Food groups are ordered by the mean misreporting error.

Food group	Consumed by (n)	Median (IQR)			Unadjusted P	Mean misreporting error (%)	Proportion of true intake recalled (%)
		Covert Weigh Back (g)	Weighed Dietary Records (g)	24-hr Recall (g)			
Salt	33	1.2 (0.5 - 2.3)	0.4 (0.3 - 2.5)	0.3 (0.1 - 0.8)	0.010	-71	20
Flours, grains & starches	12	5.6 (2.4 - 14.6)	2.3 (1.5 - 7.0)	2.4 (0.8 - 7.3)	0.320	-58	67
Sauces	36	24 (2.9 - 84)	13 (1.9 - 81)	8.3 (1 - 45)	0.030	-56	85
Oils	47	8.2 (3.2 - 12)	5.8 (2.0 - 11)	4.2 (2.5 - 7.9)	0.020	-39	66
Milk & milk based drinks & creams	55	289 AB (166 - 405)	222 AC (150 - 343)	195 BC (120 - 304)	<0.001	-28	98
Fruit	55	221 AB (110 - 365)	183 AC (85 - 337)	150 BC (101 - 323)	<0.001	-25	83
Fruit juices	28	198 A (95 - 283)	178 B (109 - 284)	132 AB (45 - 229)	<0.001	-22	85
Carbonated drinks	28	384 (183 - 491)	319 (163 - 503)	282 (118 - 486)	0.034	-22	88
Water & drinks	58	1140 AB (900 - 1554)	943 AC (652 - 1444)	868 BC (596 - 1257)	<0.001	-21	81
Condiments	48	18	15	14	0.003	-19	68

		(9.1 - 32)	(5.9 - 23)	(5.6 - 38)			
Spirits	10	24	19	20	0.121	-19	93
		(12 - 31)	(12 - 32)	(12 - 25)			
Breakfast cereals	45	46 A	40 B	35 AB	<0.001	-18	92
		(25 - 6.0)	(21 - 75)	(19 - 52)			
Meat	54	126 A	111 B	102 AB	0.001	-15	89
		(84 - 176)	(61 - 161)	(66 - 168)			
Beans, lentils, peas (pulses)	32	61	51	56	0.097	-12	90
		(31 - 98)	(27 - 102)	(27 - 116)			
Biscuits	38	21 A	20 B	16 AB	<0.001	-14	83
		(13 - 39)	(13 - 38)	(10 - 31)			
Potato chips & potato products	28	55	45	52	0.024	-12	87
		(34 - 84)	(26 - 81)	(28 - 81)			
Pasta	35	82	60	85	0.067	-12	91
		(53 - 134)	(47 - 124)	(49 - 136)			
Pizza	12	54	52	43	0.044	-12	100
		(20 - 80)	(12 - 77)	(17 - 82)			
Sugar & sweeteners	25	6.8	5.8	6.3	0.003	-11	93
		(1.6 - 19)	(0.8 - 20)	(1.4 - 15)			
Savoury snacks	43	20	18	18	0.026	-10	84
		(8.2 - 34)	(8.3 - 30)	(8.7 - 33)			
Confectionary (non-chocolate)	4	14	18	7.3	0.165	-10	96
		(7.4 - 32)	(4.7 - 34)	(3.7 - 17)			
Vegetables & vegetable dishes	57	224	210	202	0.002	-8	91
		(131 - 360)	(113 - 356)	(120 - 368)			
Sandwiches & breads	58	115 AB	110 A	103 B	<0.001	-7	80
		(82 - 170)	(74 - 144)	(66 - 150)			
Squash & cordials	18	67	85	40	0.023	-7	68
		(19 - 133)	(30 - 124)	(16 - 93)			

Potatoes	47	97 (56 - 142)	101 (48 - 121)	82 (35 - 125)	0.004	-6	92
Wines	28	107 (53 - 164)	109 (47 - 171)	99 (48 - 181)	0.220	-3	87
Confectionary (chocolate)	37	29 (17 - 55)	29 (13 - 51)	27 (19 - 61)	0.280	-3	86
Eggs	33	26 (17 - 35)	26 (15 - 35)	25 (14 - 33)	0.238	-2	83
Cakes, pastries, buns & savouries	28	40 (17 - 68)	35 (18 - 59)	46 (27 - 75)	0.134	1	84
Puddings & chilled dessert	18	36 (20 - 67)	38 (20 - 66)	35 (20 - 71)	0.720	1	80
Rice	27	46 (38 - 110)	49 (28 - 87)	47 (30 - 90)	0.084	4	79
Cheeses	46	20 (9.3 - 34)	22 (8.9 - 37)	20 (10 - 49)	0.544	5	86
Yoghurts	32	69 (29 - 159)	81 (27 - 142)	66 (30 - 133)	0.020	7	81
Fish	39	36 (20 - 65)	36 (22 - 58)	42 (27 - 54)	0.274	8	78
Syrups & preserves	41	11 (6.6 - 20)	11 (6.7 - 19)	13 (6.0 - 27)	0.087	9	91
Ice cream	25	38 (23 - 65)	32 (19 - 65)	51 (3.0 - 118)	0.001	9	91
Soups	29	67 (48 - 112)	73 (52 - 138)	75 (50 - 100)	0.409	10	89
Beers & ciders	25	232 (111 - 474)	270 (129 - 454)	250 (101 - 487)	0.022	12	89
Herbs & spices	32	0.8	1	0.8	0.662	13	52

		(0.2 - 2.3)	(0.3 - 2.9)	(0.2 - 2.4)			
Spreading fats	54	14	16	17	0.026	18	90
		(7.0 - 27)	(6.9 - 30)	(9.4 - 34)			
Nuts & seeds	11	3.7	4.7	16	0.568	180	71
		(1.2 - 25)	(1.5 - 23)	(1.2 - 23)			

IQR, Interquartile Range. Values with the same letter within each row are significantly different ($p < 0.05$) based on Friedman test followed by Wilcoxon signed rank tests and Bonferroni correction for multiple comparisons. Mean misreporting error = ((WDR – CWB)/CWB + (24-hr Recall – CWB)/CWB)) / 2 * 100. Proportion of true intake recalled the proportion (%) of foods in the CWB that were also in the 24-hr recall. See text for details.

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