

**Comparison of short questions relating to quantity  
and frequency of bread and cereal intake**

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## EXECUTIVE SUMMARY

Cereal grains are an important part of the Australian diet, emphasised by the Dietary Guideline 'Eat plenty of cereals (including breads, rice, pasta and noodles) preferably wholegrain'. The *Australian Guide to Healthy Eating* recommends that breads, cereals, rice, pasta and noodles form the basis of a healthy diet, with the greatest proportion of food coming from this group. Cereal and cereal products, particularly bread and breakfast cereals, are an important low-fat source of energy, dietary fibre, carbohydrate, protein, thiamin, folate, iron and magnesium in the Australian diet. Recent evidence supports the beneficial effects of cereal fibre and whole grains on the risk of coronary heart disease and some cancers.

The recommended number of daily cereal serves for adults aged 19 to 60 years is four to nine for women and six to 12 for men. One serve is equivalent to two slices of bread, one medium bread roll, one cup of porridge, one cup of breakfast cereal flakes, one cup of cooked rice, pasta or noodles or half a cup of muesli. National surveys indicate that the majority of adults do not meet the recommended core food group cereal targets.

The aim of this report was to compare the information obtained from short questions used in the NSW Health Survey 2002 that assess frequency and quantity of bread and cereal intake. Prior to 2002, the survey assessed bread and cereal intake using three short questions about quantity of intake. These questions were replaced by three short questions relating to frequency of intake, which were perceived to be easier for respondents to answer as well as having been recently validated in an Australian population. This validation study found that subjects tended to overestimate their frequency of bread and cereal consumption at the highest levels of intake and underestimate at the lowest levels of intake when compared to three day weighed records. This was most evident for cooked cereals, followed by breakfast cereals and least for bread intake. These caveats must be considered when interpreting data on bread and cereal intake obtained from short questions.

The study population consisted of 12,491 adults, aged between 17 and 95 years old. Females were overrepresented (57.9% of survey compared to 50.3% of NSW population) as were people aged 55 years or over (46.5% of the survey compared to 21.9% of the NSW population). Other important subgroups used in statistical analyses included age (<35, 35-54, ≥55y), BMI (<25.0, 25.0-29.9, ≥30.0), SEIFA category (1/2, 3, 4, 5) and ARIA category (1, 2, 3/4/5).

The agreement between the short questions on quantity and frequency of bread intake was moderate (weighted kappa 0.50). In addition, the weighted kappas for males, those aged 55 years and over, and those in the middle ARIA group (living in accessible areas) were lower compared to other subgroups (0.44-0.46). This may reflect real differences in consumption patterns. For example, males tended to eat higher quantities of bread per eating occasion than females, and respondents aged 55 years and over tended to eat bread more frequently but in smaller amounts than younger respondents. Thus, substituting short questions on quantity for frequency of bread intake requires careful interpretation.

By contrast, there seemed to be good agreement between the short questions on quantity and frequency of breakfast cereals (weighted kappa 0.77) and cooked cereals (weighted kappa 0.75). Analyses of agreement between quantity and frequency for these foods showed good agreement between quantity and frequency for population subgroups such as sex, age, BMI, SEIFA category and ARIA category.

In this comparison of the two question types, the total number of serves of bread and cereals could not be established for each subject. Although respondents completed all three questions relating to frequency of consumption, they were asked only one of the short questions relating to quantity of consumption. Instead, an estimate of serves consumed per day was derived based on the total frequency of bread and cereal consumption. Subjects were grouped into quintiles according to their frequency of consumption. Using this approach, it was concluded that 'very frequent' consumers ate approximately 4.2 serves of bread and cereals per day whereas 'infrequent' consumers ate 1.4 serves per day. These estimations need to be interpreted with caution, as they have not been validated using more detailed dietary intake assessments.

We recommend some further validity-testing of the three questions relating to frequency of bread and cereal intake be conducted using more detailed dietary assessment methods. This information can be used to provide an estimate of the total serves of bread and cereals consumed per day and can be compared to the recommended core food group cereal targets.

**Background:**

Cereal grains are an important part of the Australian diet, emphasised by the Dietary Guideline 'Eat plenty of cereals (including breads, rice, pasta and noodles) preferably wholegrain' (NHMRC, 199). The *Australian Guide to Healthy Eating* (AGHE) recommends that breads, cereals, rice, pasta and noodles form the basis of a healthy diet, with the greatest proportion of food coming from this group. Cereal and cereal products, particularly bread and breakfast cereals, are an important low-fat source of energy, dietary fibre, carbohydrate, protein, thiamine, folate, iron and magnesium in the Australian diet (NNS, 1995). Recent evidence supports the beneficial effects of cereal fibre and whole grains on the risk of coronary heart disease and some cancers (NHMRC, 1999; Truswell, 2002).

The recommended number of daily cereal serves for adults aged 19 to 60 years is four to nine for women and six to 12 for men (AGHE). One serve is equivalent to two slices of bread, one medium bread roll, one cup of porridge, one cup of breakfast cereal flakes, one cup of cooked rice, pasta or noodles and half a cup of muesli.

The 1995 National Nutrition Survey, found that 94.5 percent of Australians aged 19 years and over had eaten cereal foods on the day of the survey, with the most commonly consumed foods being bread (80.5%) and breakfast cereals (50.9%) (NNS, 1995). However, even among adults with the highest intakes (those aged 19–24 years), only 34 per cent of men and 21 per cent of women met the recommended core food group cereal targets (Williams, 2003). Similarly data from the Australian Longitudinal Study on Women's Health showed that only 12% of women aged 50-55 years met the dietary recommendation for bread and cereal intake of four or more serves (Ball et al, 2003).

**Project description:**

Aim: To compare the information obtained from short questions used in the NSW Health Survey that assess frequency and quantity of bread and cereal intake.

Prior to 2002, the NSW Health Surveys assessed bread and cereal intake using three short questions which related to the amount of bread and cereals consumed:

- How many slices of bread do you usually eat each day?
- How many cups of breakfast cereal do you usually eat each day?
- How many cups of cooked pasta, rice, noodles or other cooked cereals do you usually eat each week?

There were, however, no validity or reliability data to support the use of these questions. After 2002, these questions were replaced by three short questions that assessed the frequency of consumption of bread and cereal intake:

- How often do you usually eat bread?
- How often do you eat breakfast cereal?
- How often do you eat pasta, rice, noodles or other cooked cereals?

The reasons for undertaking this change in questions included the recent validation of short questions on frequency of intake in a Tasmanian study (Riley et al, 2001) as well as a perception by the interviewers that questions relating to frequency were easier for respondents to answer than questions relating to quantity. See Appendix 1 for the description, background and validity of the short questions.

There was a period of overlap where both quantity and frequency questions were asked (2002), which is the basis of this study.

**Methods:**

Data were obtained from the HOIST database comprising the NSW Health Survey 2002 cohort of 12,491 adults.

The three short questions relating to frequency of bread and cereal consumption were asked to the entire cohort, whereas the questions relating to the quantity of B&C consumption were asked to three discrete groups (bread consumption n=4074, breakfast cereal consumption n=4172, and cooked cereal consumption n=4143).

The variables relating to bread and cereal intake were recoded to provide daily (for bread and breakfast cereal) or weekly (for cooked cereals) intake data. Spearman's correlation coefficients were used to correlate non-parametric continuous data on quantity and frequency of intake. The quantity and frequency data were then categorised into four groups according to intake. Cutoff points were based on standard food serve sizes and/or category size. Crosstabs were performed and weighted kappas were calculated to determine the level of agreement between quantity and frequency of data.

Another way of classifying the respondents was according to the way their intake was reported. If bread intake was reported as 'times per day' then the respondent would be considered a 'daily consumer of bread'. Those who reported 'times per week' or 'times per month' would be considered infrequent consumers and those who reported rarely or never consuming bread would be rare/never consumers. This classification was used in the analysis for bread only to determine whether the agreement (weighted kappa) was improved when analysed within these categories.

As the total number of bread and cereal serves for each individual could not be established (persons were only asked about the quantity of either bread, breakfast cereal or cooked cereal consumption, not all three), a different approach was taken to determine the number of serves consumed per occasion. The total daily frequency of bread and cereal consumption was calculated by summation of the frequencies of daily bread intake, daily breakfast cereal intake and daily cooked cereal intake. This variable, which ranged from 0 to 15.6 times per day, was then divided into quintiles (from 1 being infrequent consumers to 5 being very frequent consumers). By using these quintiles, the quantities of bread and cereals consumed can be described within each category.

SPSS 12.0.1 for Windows was used to undertake all statistical analyses except for weighted kappas and standard errors, which were calculated using SAS version 8.

## Results and discussion:

The study population consisted of 42.1% males and 57.9% females, aged between 17 and 95 years old. The characteristics of this population are outlined in Table 1. Males were underrepresented in the survey (42.1% of survey compared to 49.7% of NSW population) while females were overrepresented (57.9% of survey compared to 50.3% of NSW population)(Centre for Epidemiology and Research, NSW Department of Health, 2002). Among both sexes, people aged 55 years or over were overrepresented (46.5% of the survey compared to 21.9% of the NSW population).

**Table 1. Characteristics of the study population**

	All n=12,491	Male n=5260	Female n=7231
Age (y; mean, sd)	51.8 (17.9)	51.3 (17.7)	52.2 (17.9)
<35 y	20.2%	20.5%	20.0%
35-54 y	33.3%	33.8%	32.9%
≥55 y	46.5%	45.7%	47.1%
BMI (kg/m <sup>2</sup> ; mean, sd)	25.9 (5.3)	26.3 (4.9)	25.5 (5.6)
<25.0	50.0%	43.9%	54.5%
25.0-29.99	32.9%	39.8%	27.6%
≥30.0	17.2%	16.3%	17.8%
SEIFA category			
1 or 2 (least disadvantaged)	20.6%	20.7%	20.5%
3	21.1%	20.5%	21.5%
4	30.8%	31.5%	30.3%
5 (most disadvantaged)	27.5%	27.2%	27.7%
ARIA category			
1 (highly accessible)	60.5%	59.9%	60.9%
2 (accessible)	27.1%	27.5%	26.8%
3, 4 or 5 (mod accessible, remote, very remote)	11.3%	11.5%	11.3%

**(A) Consumption of bread (includes bread rolls, flat breads, crumpets, bagels, English or bread type muffins)**

Tables 2 and 3 list the reported quantity and frequency of bread consumption by the study population per day. Men consumed more slices of bread per day than women; 55.9% of men consumed four or more slices compared to 28.0% of women. The majority of people (75.3%) consumed bread once or twice a day. The proportion of the population who rarely or never consumed bread was 3.3%.

**Table 2. Slices of bread consumed per day by sex**

Slices of bread	All n=4074	Male n=1747	Female n=2327
0 - <2	16.4%	11.4%	20.2%
2 - <4	43.7%	32.7%	51.9%
4 - <6	27.9%	33.3%	23.9%
6 - 22	12.0%	22.6%	4.1%
Total	100.0%	100.0%	100.0%

**Table 3. Frequency of bread consumption by sex**

Frequency of bread consumption	All n=12,466	Male n=5253	Female n=7213
0- <1/d	13.7%	11.1%	15.1%
1- <2/d	38.9%	35.7%	41.2%
2- <3/d	36.4%	37.7%	35.4%
≥3/d	11.1%	15.6%	7.8%
Total	100.0%	100.0%	100.0%

**Relationship between quantity and frequency of bread consumption**

Table 5 compares the quantity and frequency of bread consumption. The weighted kappa for this analysis was 0.50 (ASE 0.011).

**Table 5. All: Crosstab of slices of bread categories and frequency categories**

		Frequency categories				Total	
		0- <1/day	1- <2/day	2- <3/day	≥3/day		
Slices/day	0-<2 slices	Count	419	223	17	7	666
		% within freqbreadcat	71.9%	14.1%	1.1%	1.7%	16.4%
	2-<4 slices	Count	112	1024	587	56	1779
		% within freq breadcat	19.2%	64.5%	39.3%	13.7%	43.7%
	4-<6 slices	Count	43	285	679	130	1137
		% within freqbreadcat	7.4%	18.0%	45.5%	31.9%	27.9%
	≥6 slices	Count	9	55	209	215	488
		% within freqbreadcat	1.5%	3.5%	14.0%	52.7%	12.0%
Total		Count	583	1587	1492	408	4070
		% within freqbreadcat	100.0%	100.0%	100.0%	100.0%	100.0%

**Table 6. Subgroup analysis for bread intake: Spearman's rho and weighted kappa**

	n	Spearman's rho	Weighted kappa	A. Std Error
All	4070	0.67	0.50	0.011
Male	1744	0.62	0.46	0.016
Female	2326	0.71	0.51	0.014
<35 y	817	0.69	0.53	0.023
35-54 y	1355	0.72	0.55	0.017
≥55 y	1898	0.64	0.44	0.016
BMI<25.0	1954	0.63	0.51	0.015
BMI 25.0-29.9	1264	0.61	0.49	0.019
BMI>30.0	662	0.60	0.49	0.026
SEIFAcad1	845	0.67	0.55	0.022
SEIFAcad3	851	0.61	0.49	0.023
SEIFAcad4	1209	0.59	0.47	0.019
SEIFAcad5	1165	0.60	0.50	0.020
ARIAcat1	2549	0.69	0.52	0.013
ARIAcat2	1058	0.63	0.44	0.021
ARIAcat3	417	0.69	0.52	0.033

The weighted kappas ranged from 0.44 to 0.55 in the various subgroups examined (Table 6), implying there is moderate agreement (as defined by Altman, 1991) between the short questions on quantity and frequency of bread intake. The lowest kappas were found for males, those aged 55 years and over and those in the middle ARIA category (0.44-0.46). These subgroups have been examined in more detail below.

### Male/female

Differences in bread consumption patterns between males and females are demonstrated in Tables 7 and 8 and summarised as follows:

- If bread consumed <1/day: 62% of males had 0 -<2 slices, 77% of females had 0 -<2 slices.
- If bread consumed 1-<2/day: 53% of males had 2 -<4 slices, 30% had 4-<6 slices  
72% of females had 2 -<4 slices
- If bread consumed 2-<3/day: 27% of males had 2 -<4 slices, 47% had 4-<6 slices,  
and 26% had  $\geq 6$  slices  
50% of females had 2-<4 slices, 45% had 4-<6 slices
- If bread consumed  $\geq 3$ /day: 67% of males had  $\geq 6$  slices  
47% of females had 4-<6 slices, 30% had  $\geq 6$  slices

**Table 7. Males: Crosstab of slices of bread categories and frequency categories**

		Frequency categories				Total	
		0- <1/d	1- <2/d	2- <3/d	$\geq 3$ /d		
Slices/day	0-<2	Count	126	63	7	2	198
		% within freqbreadcat	61.8%	10.1%	1.0%	.8%	11.4%
	2-<4	Count	42	328	178	24	572
		% within freqbreadcat	20.6%	52.6%	26.6%	9.7%	32.8%
	4-<6	Count	29	186	311	55	581
		% within freqbreadcat	14.2%	29.8%	46.5%	22.3%	33.3%
	$\geq 6$	Count	7	47	173	166	393
		% within freqbreadcat	3.4%	7.5%	25.9%	67.2%	22.5%
Total		Count	204	624	669	247	1744
		% within freqbreadcat	100.0%	100.0%	100.0%	100.0%	100.0%

**Table 8. Females: Crosstab of slices of bread categories and frequency categories**

		Frequency categories				Total	
		0- <1/d	1- <2/d	2- <3/d	$\geq 3$ /d		
Slices/day	0-<2	Count	293	160	10	5	468
		% within freqbreadcat	77.3%	16.6%	1.2%	3.1%	20.1%
	2-<4	Count	70	696	409	32	1207
		% within freqbreadcat	18.5%	72.3%	49.7%	19.9%	51.9%
	4-<6	Count	14	99	368	75	556
		% within freqbreadcat	3.7%	10.3%	44.7%	46.6%	23.9%
	$\geq 6$	Count	2	8	36	49	95
		% within freqbreadcat	.5%	.8%	4.4%	30.4%	4.1%
Total		Count	379	963	823	161	2326
		% within freqbreadcat	100.0%	100.0%	100.0%	100.0%	100.0%

### Age groups

Differences in consumption patterns according to age group are shown in Tables 9, 10 and 11. In the age group >55 years, respondents who eat bread three or more times a day tend to eat fewer slices of bread than those in younger age groups. More detailed subgroup analysis by age group can be found in Appendix 2. The weighted kappa was generally lowest (0.42-0.48) in the >55 years age group. The age group with the highest level of agreement was the 35-54 year age group (weighted kappas ranged from 0.48-0.59; considered to be 'moderate agreement').

**Table 9. Aged <35 years: Crosstab of slices of bread categories and frequency categories**

		Frequency categories				Total	
		0- <1/d	1- <2/d	2- <3/d	>3/d		
Slices/day	0-<2	Count	103	40	3	3	149
		% within freqbreadcat	69.1	12.6	1.1	3.6	18.2
	2-<4	Count	25	187	78	5	295
		% within freqbreadcat	16.8	59.0	29.1	6.0	36.1
	4-<6	Count	19	75	129	15	238
		% within freqbreadcat	12.8	23.7	48.1	18.1	29.1
	≥6	Count	2	15	58	60	135
		% within freqbreadcat	1.3	4.7	21.6	72.3	16.5
Total		Count	149	317	268	83	817
		% within freqbreadcat	100.0%	100.0%	100.0%	100.0%	100.0%

**Table 10. Aged 35-54 years: Crosstab of slices of bread categories and frequency categories**

		Frequency categories				Total	
		0- <1/d	1- <2/d	2- <3/d	>3/d		
Slices/day	0-<2	Count	182	80	6	2	270
		% within freqbreadcat	74.3	14.6	1.3	1.8	19.9
	2-<4	Count	44	353	144	8	549
		% within freqbreadcat	18.0	64.2	32.2	7.1	40.5
	4-<6	Count	15	95	214	32	356
		% within freqbreadcat	6.1	17.3	47.9	28.3	26.3
	≥6	Count	4	22	83	71	180
		% within freqbreadcat	1.6	4.0	18.6	62.8	13.3
Total		Count	245	550	447	113	1355
		% within freqbreadcat	100.0%	100.0%	100.0%	100.0%	100.0%

**Table 11. Aged  $\geq 55$  years: Crosstab of slices of bread categories and frequency categories**

			Frequency categories				Total
			0- <1/d	1- <2/d	2- <3/d	$\geq 3/d$	
Slices/day	0-<2	Count	134	103	8	2	247
		% within freqbreadcat	70.9	14.3	1.0	0.9	13.0
	2-<4	Count	43	484	365	43	935
		% within freqbreadcat	22.8	67.2	47.0	20.3	49.3
	4-<6	Count	9	115	336	83	543
		% within freqbreadcat	4.8	16.0	43.2	39.2	28.6
	$\geq 6$	Count	3	18	68	84	173
		% within freqbreadcat	1.6	2.5	8.8	39.6	9.1
Total		Count	189	720	777	212	1898
		% within freqbreadcat	100.0%	100.0%	100.0%	100.0%	100.0%

### ARIA groups

ARIA category 2 (those living in accessible areas) had a lower kappa for agreement on frequency and quantity of bread intake compared to the other two categories. This may be a real difference in consumption patterns or may be due to confounding. Respondents in ARIA categories 2 and 3 tended to be older than those in category 1.

**Table 12. Crosstab of age and ARIA categories**

Age, y		ARIA category		
		1	2	3
<35	% within ariacat	23.1%	15.1%	16.5%
35-54	% within ariacat	33.5%	32.3%	34.2%
>55	% within ariacat	43.3%	52.6%	49.3%
Total		100.0%	100.0%	100.0%

### Summary for bread intake:

Overall, there was a positive association between the reported frequency of consumption and average daily slices of bread consumed. The agreement between the short questions on quantity and frequency of bread intake seems to be moderate. The weighted kappas for males, those aged 55 years and over and those in the middle ARIA group tended to be lower compared to other subgroups. This may reflect differences in consumption patterns. For example, males tend to eat more slices of bread per eating occasion (frequency) than females. Respondents aged 55 years and over tended to eat bread more frequently but in smaller amounts than younger respondents. Those in ARIA category 2, (ie. those living in accessible areas) were more likely to be aged 55 years or over which may have contributed to a lower kappa statistic.

### Daily consumers, infrequent consumers and rare consumers

By classifying the respondents into groups according to frequency of bread intake; three broad groups were formed: daily consumers of bread, infrequent consumers of bread (weekly or monthly consumption) or rare/never consumers of bread.

Of those who were classified as daily consumers, 99.3% reported their bread intake in slices per day, which showed this was a good indicator of daily bread consumption (Table 13). Of those classified as infrequent consumers, only 42% reported their bread intake in slices per week while 53% reported intake per day. This category was therefore not a very good indicator of infrequent bread consumption. Of those classified as rare consumers, 91.0% reported their bread intake as rare or never.

**Table 13. Reported bread intake by frequency category**

	Reported bread intake per day	Reported bread intake per week	Reported not eating bread
<b>Daily consumers:</b> reported frequency per day (n=3487)	99.3%	0.6%	0.1%
<b>Infrequent consumers:</b> reported frequency per week or month (n=461)	53.1%	41.9%	5.0%
<b>Rare consumers:</b> reported frequency as rarely or never (n=122)	5.4%	4.1%	91.0%

For daily consumers who reported bread intake per day, the weighted kappa for frequency and quantity of bread consumption was 0.50 (ASE 0.013) for all respondents; 0.42 (ASE 0.019) for males and 0.56 (ASE 0.017) for females. For infrequent consumers who reported bread intake per week, the weighted kappa was 0.45 (n=193) (see Appendix 3 for crosstabs). These weighted kappas were the same or similar as those reported in Table 6 for the entire study population and subgroups.

**(B) Consumption of breakfast cereal (ready-made, home-made or cooked)**

Tables 14 and 15 describe the reported daily quantity and frequency of breakfast cereal consumption. Nearly half of the population (49.0%) consumed breakfast cereal once a day or more while 26.6% rarely or never consumed breakfast cereal,

**Table 14. Cups of breakfast cereal eaten per day**

Cups of breakfast cereal	All n=4172	Male n=1740	Female n=2432
0 cups	30.7%	31.4%	30.1%
>0 - <1 cup	14.7%	12.8%	16.1%
1 - <2 cups	43.0%	38.3%	46.4%
≥ 2 cups	11.6%	17.4%	7.4%
Total	100.0%	100.0%	100.0%

**Table 15. Frequency of breakfast cereal consumption**

Frequency of breakfast cereal	All n=12,457	Male n=5252	Female n=7205
Rarely/never	26.6%	27.3%	26.2%
<1/d	24.4%	23.6%	25.0%
1 - <2/d	48.4%	48.2%	48.5%
≥2/d	0.6%	0.8%	0.4%
Total	100.0%	100.0%	100.0%

**Relationship between quantity and frequency of BF cereal consumption**

Table 16 shows the agreement between daily reported quantity and frequency of consumption of breakfast cereal with a weighted kappa was 0.77 (SE 0.007).

**Table 16. All: Crosstab of cups of BF cereal and frequency of BF cereal**

Cups per day		Frequency categories per day				Total
		0 times	<1 times	1-<2 times	≥2 times	
0 cups	Count	1186	91	1	0	1278
	% within freq/day	98.7%	9.8%	.0%	.0%	30.7%
0 - <1 cup	Count	10	507	97	1	615
	% within freq/day	.8%	54.9%	4.8%	5.6%	14.8%
1 -<2 cups	Count	6	273	1510	4	1793
	% within freq/day	.5%	29.5%	74.6%	22.2%	43.0%
≥2 cups	Count	0	53	416	13	482
	% within freq/day	.0%	5.7%	20.6%	72.2%	11.6%
Total	Count	1202	924	2024	18	4168
	% within freq/day	100.0%	100.0%	100.0%	100.0%	100.0%

The weighted kappas and Spearman correlation coefficients for the various subgroups analysed are shown in Table 17. The weighted kappas ranged from 0.71 to 0.79 indicating good agreement between the two questions with the Spearman's correlation coefficients ranging from 0.85 to 0.91.

**Table 17. Subgroup analysis for breakfast cereal intake: Spearman's rho and weighted kappa**

	n	Spearman's rho	Weighted kappa	A. Std Error
All	4168	0.88	0.77	0.007
Male	1739	0.87	0.73	0.010
Female	2429	0.88	0.79	0.009
<35 y	850	0.89	0.71	0.015
35-54 y	1368	0.91	0.77	0.011
≥55 y	1950	0.85	0.78	0.010
BMI<25.0	1986	0.85	0.75	0.010
BMI 25.0-29.9	1290	0.85	0.76	0.013
BMI>30.0	685	0.89	0.79	0.015
SEIFAcat1	837	0.86	0.77	0.015
SEIFAcat3	876	0.86	0.75	0.015
SEIFAcat4	1317	0.86	0.77	0.012
SEIFAcat5	1138	0.87	0.77	0.013
ARIAcat1	2460	0.87	0.76	0.009
ARIAcat2	1195	0.87	0.77	0.012
ARIAcat3	471	0.90	0.79	0.019

### Male/female

The patterns of breakfast cereal consumption were quite similar for males and females (see Tables 18 and 19) and can be summarized as follows:

If BF cereal consumed rarely or never: most (99%) had 0 cups  
 If BF cereal consumed <1/day: most (55%) had < 1 cup  
 If BF cereal consumed 1-<2/day: most (75%) had 1-<2cups  
 If BF cereal consumed  $\geq 2$ /day\*: most males (85%) had  $\geq 2$  cups  
 most females (60%) had 1-<2cups

\*very small numbers

**Table 18. Males: Crosstab of cups of BF cereal and frequency of BF cereal**

Cups per day		Frequency categories per day				Total
		0 times	<1 times	1-<2 times	$\geq 2$ times	
0 cups	Count	507	39	1	0	547
	% within freq/day	99.0%	10.4%	.1%	.0%	31.5%
0 - <1 cup	Count	4	196	22	1	223
	% within freq/day	.8%	52.1%	2.6%	7.7%	12.8%
1 - <2 cup	Count	1	110	554	1	666
	% within freq/day	.2%	29.3%	66.1%	7.7%	38.3%
$\geq 2$ cups	Count	0	31	261	11	303
	% within freq/day	.0%	8.2%	31.1%	84.6%	17.4%
Total	Count	512	376	838	13	1739
	% within freq/day	100.0%	100.0%	100.0%	100.0%	100.0%

**Table 19. Females: Crosstab of cups of BF cereal and frequency of BF cereal**

Cups per day		Frequency categories per day				Total
		0 times	<1 times	1-<2 times	$\geq 2$ times	
0 cups	Count	679	52	0	0	731
	% within freq/day	98.4%	9.5%	.0%	.0%	30.1%
0 - <1 cup	Count	6	311	75	0	392
	% within freq/day	.9%	56.8%	6.3%	.0%	16.1%
1 - <2 cup	Count	5	163	956	3	1127
	% within freq/day	.7%	29.7%	80.6%	60.0%	46.4%
$\geq 2$ cups	Count	0	22	155	2	179
	% within freq/day	.0%	4.0%	13.1%	40.0%	7.4%
Total	Count	690	548	1186	5	2429
	% within freq/day	100.0%	100.0%	100.0%	100.0%	100.0%

More detailed subgroup analysis by age group can be found in Appendix 2.

### **(C) Consumption of pasta, rice, noodles or other cooked cereals**

Tables 20 and 21 summarise the quantity and frequency of cooked cereal consumption per week by the study population. Nearly half of the respondents (47.6%) consumed cooked cereal once or twice a week (<3/wk), while approximately 10% rarely or never consumed cooked cereals and another 10% consumed it daily.

**Table 20. Cups of cooked cereal eaten per week by sex**

Cups of cooked cereal	All n=4143	Male n=1728	Female n=2415
0 cups	13.4%	15.6%	11.9%
>0 - <3 cups	40.4%	39.5%	41.0%
3 - <7 cups	34.5%	33.3%	35.4%
≥ 7 cups	11.7%	11.6%	11.7%
Total	100.0%	100.0%	100.0%

**Table 21. Frequency of cooked cereal consumption by sex**

Frequency of cooked cereal	All n=12,440	Male n=5238	Female n=7202
Rarely/never	9.5%	11.6%	8.0%
<3/wk	47.6%	48.4%	47.0%
3 - <7/wk	32.9%	30.7%	34.5%
≥7/wk	10.0%	9.4%	10.5%
Total	100.0%	100.0%	100.0%

### ***Relationship between quantity and frequency of cooked cereal consumption***

Table 22 demonstrates the agreement between the weekly reported quantity and frequency of cooked cereal consumption. The weighted kappa was 0.75 (SE 0.009) implying good agreement between the two short questions. The consumption patterns for cooked cereal may be summarised as follows:

If cooked cereal consumed rarely or never: most (96%) have 0 cups  
If cooked cereal consumed <3/week: most (78%) have <3 cups  
If cooked cereal consumed 3-<7/week: most (85%) have 3-<7 cups  
If cooked cereal consumed ≥7/day: most (75%) have ≥7 cups

Weighted kappas remained similar (0.73 to 0.79) when the various subgroups were analysed (Table 23). Spearman's correlation coefficients ranged from 0.77 to 0.88.

**Table 22. All: Crosstab of cups of cooked cereal and frequency of cooked cereal**

Cups per week		Frequency categories per week				Total
		0 times	<3 times	3- <7 times	> 7 times	
0 cups	Count	388	158	7	4	557
	% within freq cereal	96.0%	8.0%	.5%	1.0%	13.5%
<3 cups	Count	8	1526	99	40	1673
	% within freq cereal	2.0%	77.7%	7.2%	10.0%	40.4%
3-<7 cups	Count	3	208	1163	54	1428
	% within freq cereal	.7%	10.6%	84.7%	13.5%	34.5%
≥ 7 cups	Count	5	73	104	301	483
	% within freq cereal	1.2%	3.7%	7.6%	75.4%	11.7%
Total	Count	404	1965	1373	399	4141
	% within freq cereal	100.0%	100.0%	100.0%	100.0%	100.0%

**Table 23. Subgroup analysis for cooked cereal intake: Spearman's rho and weighted kappa**

	n	Spearman's rho	Weighted kappa	A. Std Error
All	4141	0.84	0.75	0.009
Male	1726	0.83	0.75	0.013
Female	2415	0.85	0.76	0.011
<35 y	840	0.81	0.75	0.020
35-54 y	1412	0.81	0.74	0.016
≥55 y	1889	0.85	0.73	0.014
BMI<25.0	1952	0.81	0.76	0.012
BMI 25.0-29.9	1315	0.79	0.74	0.016
BMI>30.0	681	0.80	0.74	0.022
SEIFAcad1	872	0.77	0.74	0.020
SEIFAcad3	886	0.81	0.76	0.018
SEIFAcad4	1292	0.80	0.74	0.016
SEIFAcad5	1091	0.82	0.77	0.016
ARIAcat1	2491	0.84	0.75	0.011
ARIAcat2	1099	0.85	0.73	0.017
ARIAcat3	511	0.88	0.79	0.022

**Male/female**

There were few differences in consumption patterns between males and females (Tables 24 and 25).

**Table 24. Males: Crosstab of cups of cooked cereal and frequency of cooked cereal**

Cups per week		Frequency category per week				Total
		0 times	<3 times	3- <7times	≥ 7 times	
0 cups	Count	192	72	2	3	269
	% within freq/week	96.5%	8.6%	.4%	1.9%	15.6%
<3 cups	Count	4	626	33	19	682
	% within freq/week	2.0%	75.1%	6.1%	12.2%	39.5%
3-<7 cups	Count	1	103	455	15	574
	% within freq/week	.5%	12.4%	84.7%	9.6%	33.3%
≥ 7 cups	Count	2	33	47	119	201
	% within freq/week	1.0%	4.0%	8.8%	76.3%	11.6%
Total	Count	199	834	537	156	1726
	% within freq/week	100.0%	100.0%	100.0%	100.0%	100.0%

**Table 25. Females: Crosstab of cups of cooked cereal and frequency of cooked cereal**

Cups per week		Frequency category per week				Total
		0 times	<3 times	3- <7times	≥ 7 times	
0 cups	Count	196	86	5	1	288
	% within freq/week	95.6%	7.6%	.6%	.4%	11.9%
<3 cups	Count	4	900	66	21	991
	% within freq/week	2.0%	79.6%	7.9%	8.6%	41.0%
3-<7 cups	Count	2	105	708	39	854
	% within freq/week	1.0%	9.3%	84.7%	16.0%	35.4%
≥ 7 cups	Count	3	40	57	182	282
	% within freq/week	1.5%	3.5%	6.8%	74.9%	11.7%
Total	Count	205	1131	836	243	2415
	% within freq/week	100.0%	100.0%	100.0%	100.0%	100.0%

More detailed subgroup analysis by age group can be found in Appendix 2.

**(D) Relationship between quantity and frequency of total bread and cereal consumption.**

By using quintiles of frequency of total bread and cereal consumption (see Methods), the average quantities consumed can be established for each category. Table 26 shows that as a group, 'very frequent' consumers eat an average of 4.7 slices of bread, 1.1 cups of breakfast cereal and 0.65 cups of cooked cereal per day, roughly equivalent to 4.2 serves of bread and cereals. 'Infrequent' consumers, on the other hand, eat only approximately 1.4 serves per day.

**Table 26. Characteristics of bread and cereal consumers according to frequency of intake**

Consumer quintile	Frequency (per day)	Bread (mean slices)	Breakfast cereal (mean cups)	Cooked cereal (mean cups)
1 Infrequent	0-1.6	1.8	0.21	0.32
2	1.6-2.1	2.5	0.76	0.42
3	2.2-2.6	2.9	0.76	0.45
4	2.6-3.3	3.6	0.89	0.49
5 Very frequent	3.3-15.6	4.7	1.12	0.64

Tables 27 and 28 report the data for males and females. "Very frequent" male consumers eat approximately 4.7 serves per day (5.5 slices of bread, 1.3 cups of breakfast cereal and 0.6 cups of cooked cereal), while 'infrequent' male consumers eat approximately 1.7 serves per day. 'Very frequent' female consumers eat approximately 3.6 serves a day (3.8 slices of bread, 1 cup of breakfast cereal and 0.7 cup of cooked cereal) compared to 1.3 serves for 'infrequent' female consumers.

**Table 27. Males: Characteristics of bread and cereal consumers according to frequency of intake**

Consumer quintile	Frequency (per day)	Bread (mean slices)	Breakfast cereal (mean cups)	Cooked cereal (mean cups)
1 Infrequent	0-1.6	2.3	0.21	0.31
2	1.6-2.1	3.0	0.82	0.44
3	2.2-2.6	3.5	0.80	0.41
4	2.6-3.3	4.2	0.96	0.48
5 Very frequent	3.3-15.6	5.5	1.29	0.61

**Table 28. Females: Characteristics of bread and cereal consumers according to frequency of intake**

Consumer quintile	Frequency (per day)	Bread (mean slices)	Breakfast cereal (mean cups)	Cooked cereal (mean cups)
1 Infrequent	0-1.6	1.6	0.21	0.32
2	1.6-2.1	2.1	0.72	0.41
3	2.2-2.6	2.6	0.73	0.48
4	2.6-3.3	3.2	0.84	0.50
5 Very frequent	3.3-15.6	3.8	0.95	0.68

Tables 29 to 31 report the data for the different age categories. “Very frequent” consumers aged < 35 years eat approximately 4.7 serves per day (5.4 slices of bread, 1.2 cups of breakfast cereal and 0.8 cups of cooked cereal), while ‘infrequent’ consumers eat approximately 1.6 serves per day. ‘Very frequent’ consumers aged  $\geq$  55 years eat approximately 3.8 serves per day (4.3 slices of bread, 1.1 cup of breakfast cereal and 0.5 cup of cooked cereal) compared to 1.4 serves for ‘infrequent’ consumers.

**Table 29. Age <35 years: Characteristics of bread and cereal consumers according to frequency of intake**

Consumer quintile	Frequency (per day)	Bread (mean slices)	Breakfast cereal (mean cups)	Cooked cereal (mean cups)
1 Infrequent	0-1.6	1.8	0.16	0.48
2	1.6-2.1	2.6	0.74	0.68
3	2.2-2.6	3.1	0.72	0.49
4	2.6-3.3	3.9	0.89	0.76
5 Very frequent	3.3-15.6	5.4	1.20	0.83

**Table 30. Age 35-54 years: Characteristics of bread and cereal consumers according to frequency of intake**

Consumer quintile	Frequency (per day)	Bread (mean slices)	Breakfast cereal (mean cups)	Cooked cereal (mean cups)
1 Infrequent	0-1.6	1.8	0.18	0.33
2	1.6-2.1	2.3	0.70	0.56
3	2.2-2.6	3.1	0.73	0.56
4	2.6-3.3	3.7	0.79	0.64
5 Very frequent	3.3-15.6	4.7	1.07	0.72

**Table 31. Age  $\geq$ 55 years: Characteristics of bread and cereal consumers according to frequency of intake**

Consumer quintile	Frequency (per day)	Bread (mean slices)	Breakfast cereal (mean cups)	Cooked cereal (mean cups)
1 Infrequent	0-1.6	1.8	0.28	0.22
2	1.6-2.1	2.6	0.82	0.20
3	2.2-2.6	2.7	0.79	0.36
4	2.6-3.3	3.5	0.95	0.32
5 Very frequent	3.3-15.6	4.3	1.10	0.49

## Conclusion

In summary, there is only moderate agreement between the short questions on quantity and frequency of bread intake. Sex and age differences are also present in bread consumption patterns. This suggests that these questions should be interchanged with caution.

In contrast, there seems to be good agreement between the short questions on quantity and frequency of breakfast cereal intake and cooked cereal intake. Subgroup analysis also showed good agreement.

Quantities of breads and cereals consumed may be estimated based on their total frequency of intake although this process needs validation by cross checking with more detailed dietary intake assessments.

Previous validation studies on short questions have shown that subjects tend to overestimate their frequency of bread and cereal consumption at the highest estimate of intake and tend to underestimate at the lowest estimate of intake compared to three day weighed records (Appendix 1; Riley et al, 2001). This was most evident for cooked cereals, followed by breakfast cereals and least for bread intake. These caveats must be considered when interpreting data on short questions.

## APPENDIX 1

### *Short questions*

How many slices of bread do you usually eat each day?

(One slice of bread is equal to 1 small bread roll or 1 bagel or ½ a large bread roll or ½ bread muffin or 1 scone or ½ a pita bread)

1. \_\_\_ Slices per day
2. \_\_\_ Slices per week
3. Don't eat bread
- X. Don't know
- R. Refused

How often do you usually eat bread? (include bread rolls, flat breads, crumpets, bagels, English or bread type muffins)

1. \_\_\_ Times per day
2. \_\_\_ Times per week
3. \_\_\_ Times per month
4. Rarely or never
- X. Don't know
- R. Refused

How many cups of breakfast cereal do you usually eat each day?

(one cup is equal to 1 cup of cornflakes or other flake-based muesli; 2 weetbix; ½ cup of cooked porridge; 1/3 cup of oat-based muesli or ½ cup of allbran)

1. \_\_\_ Cups per day
2. \_\_\_ Cups per week
3. Don't eat breakfast cereal
- X. Don't know
- R. Refused

How often do you eat BF cereal? (ready-made, home-made or cooked)

1. \_\_\_ Times per day
2. \_\_\_ Times per week
3. \_\_\_ Times per month
4. Rarely or never
- X. Don't know
- R. Refused

How many cups of cooked pasta, rice, noodles, or other cooked cereals do you usually eat each week? (not including cooked breakfast cereals).

1. \_\_\_ Cups per day
2. \_\_\_ Cups per week
3. Don't eat these foods
- X. Don't know
- R. Refused

How often do you eat pasta, rice, noodles or other cooked cereals? (not including cooked BF cereals)

1. \_\_\_Times per day
2. \_\_\_Times per week
3. \_\_\_Times per month
4. \_\_\_Rarely or never
- X. Don't know
- R. Refused

### ***Background to short questions on quantity***

(From NSW Food and Nutrition Monitoring Project. Measuring key aspects of food habits and food intakes in population-based surveys in NSW: Recommendations for short modules. NSW Health, 1998)

These short questions were adapted by the NSW Food and Nutrition Monitoring Project Team from the ABS Health Behaviours and Risk Factors State Supplementary Survey, NT 1994 (ABS, 1995) to provide estimates of 'usual' number of serves.

The target group is the adult population of NSW.

Main uses of the information provided by the questions:

- To track the impact of the total effort to increase B&C intake (ie. Monitor intakes over time)
- To provide support for intervention programs to increase B&C intake
- To assess the effectiveness of intervention strategies to increase B&C intake
- To identify areas and population subgroups at risk of low B&C intake (eg, age groups, sexes and urban/rural)
- Using the three recommended questions provides information about categories of breads or cereals eaten, useful for the development of promotional campaigns and other interventions.
- The validity and repeatability of these questions has not been assessed, nor its responsiveness to change (NSW Health, Recommendations for short modules, 1998)
- Indicators that can be derived from these questions include:
  - Mean/median number of serves of bread eaten per day
  - Mean/median number of serves of pasta, rice and other cooked cereals eaten per day
  - Mean/median number of serves of breakfast cereals eaten per day
  - Mean/median number of serves of total B&C eaten per day
  - Proportion of the population who usually do not consume any breads
  - Proportion of the population who usually do not consume any breakfast cereals
  - Proportion of the population meeting recommendations for consumption of total B&C.

#### Main advantages of these three short questions

- Data directly comparable with recommendations for B&C intake which are expressed in terms of 'reference' serves.
- Questions refer to 'usual' intake therefore should provide good estimates of the variability of responses as well as central tendency.
- Using the three questions provides information about the types of B&C eaten, useful for development of interventions.
- Can be used as an 'index' for analysis of total B&C intake or analysed separately to provide information about food habits relating to intake of B&C.

#### Main disadvantages of these three short questions

- Questions not included in 'A guide to instruments for monitoring food intake, food habits and dietary change' (Coles-Rutishauser 1996) therefore unlikely to be used by others conducting such surveys.
- No information about the validity or repeatability of this instrument.
- Estimating number of 'serves' eaten is more difficult for respondents than estimating frequency of consumption alone.

#### Rationale:

- Wide range of uses/users
- State priority
- Provides trend data for tracking progress toward goals and targets
- No alternative data sources provide regular information about trends in consumption of B&C for NSW
- Provides trend data for monitoring impact of programs.
- No other currently available short questions on total B&C intake which have been used in large studies in Australia or NSW
- No other currently available short questions on usual serves of B&C intake
- Provides information on the types of B&C eaten
- Questions on frequency of intake are being validated in Tasmania
- Use of 'serve' data is consistent with that collected for F&V and allows direct comparison with recommendations.

## **Background and validity of short questions on frequency**

(From Riley M, Rutishauser IHE, Webb K. Comparison of short questions with weighed food records. Commonwealth of Australia, 2001.)

All questions were sourced from the 1996 NHMRC Dietary Key Indicators Study.

### **A. How often do you eat bread? (include bread rolls, flat breads, crumpets, bagels, English or bread type muffins)**

Comments: useful as indicator of bread intake as a component of total breads and cereals and as an indicator of thiamine intake.

In general, the response to the short question on bread consumption was distributed in a similar way in the population subgroups examined.

#### **Direct validity:**

*Short question (reported) compared to recorded 3-day WR*

	<i>Freq</i>	<i>Quantity</i>	<i>Recorded intake</i>	
<1/day	0.81	(69 g/d)	15.3% no intake	n=118
1-<2/day	1.24	(109 g/d)	1.0% no intake	n=309
2-<3/day	1.69	(135 g/d)	1.0% no intake	n=301
≥3/day	1.88	(161 g/d)	1.5% no intake	n=66
	p<0.001	p<0.001		

- Positive association between reported frequency of consumption and average daily weight of bread consumed.
- Men had a higher average daily weight of bread intake than women
- Positive association between reported frequency of consumption and mean daily frequency of bread intake (Spearman cc 0.53 for men and 0.45 for women)
- Bread intake is overestimated by SQ at the higher estimates of intake (cf observed frequencies (WR) 1.7 and 1.9 to expected frequencies of at least 2.0 and 3.0, respectively).
- Bread intake may be underestimated at the lower estimates of intake but this is not obvious from the table
- The mean WR/SQ (recorded mean frequency minus reported mean frequency) was -0.09 (95% CI -0.14 to -0.04) which suggests that on average, subjects over report their frequency of having bread by a small amount (one occasion every 10 days). This is not of public health importance.
- The extent of error reporting seems unaffected by population subgroup.

#### **Indirect validity:**

*incr in fibre, thiamine p<0.001; incr in CHO, energy, thiamine density p<0.01*

*eg thiamine*

<1/d	1.3 mg/d
1-<2/d	1.6
2-<3/d	1.7
≥3/d	1.45
	1.9

- Positive association between reported frequency of consumption of bread and mean daily energy intake, dietary fibre, thiamine and CHO intake.
- Spearman correlation coefficients were modest (0.1-0.21)

## **B. How often do you eat BF cereal? (ready-made, home-made or cooked)**

Comments: useful as indicator of BF cereal consumption as a component of B&C.

Older people were less likely to report eating BF cereal infrequently.

People with a high BMI were more likely to report eating BF cereal infrequently.

People in the highest SEIFA category were more likely to report eating BF cereal once a day or more, while people in the lowest SEIFA category reported the lowest intake in this category.

Conversely, the percentage reporting eating BF cereal rarely or never was highest in the lowest SEIFA category and lowest in the highest SEIFA category.

### **Direct validity:**

*Short question (reported) compared to recorded 3-day WR*

	<i>Daily freq (exp freq)</i>	<i>Quantity</i>	<i>Recorded intake</i>
<i>Rarely/never</i>	<i>0.04 (&lt;0.03)</i>	<i>3 g/d</i>	<i>89% no intake</i>
<i>1/mt-&lt;2/wk</i>	<i>0.19 (0.03-&lt;0.28)</i>	<i>10 g/d</i>	<i>58% no intake</i>
<i>2/wk-&lt;7/wk</i>	<i>0.50 (0.28-&lt;1.0)</i>	<i>36 g/d</i>	<i>22% no intake</i>
<i>≥7/wk</i>	<i>0.88 (≥1.0)</i>	<i>63 g/d</i>	<i>4% no intake</i>
	<i>p&lt;0.001</i>	<i>p&lt;0.001</i>	

- Positive association between reported frequency of consumption and average daily weight of BF cereal consumed.
- Positive association between reported frequency of consumption and mean daily frequency of BF cereal intake (Spearman cc 0.80 for men and 0.81 for women)
- BF cereal intake is overestimated by SQ at the highest estimate of intake and underestimated at the lowest estimate of intake, although this was to a lesser extent than for the cooked cereals.
- The mean WR/SQ (recorded mean frequency minus reported mean frequency) was  $-0.04$  (95% CI  $-0.07$  to  $0.01$ ) suggesting that on average, subjects responding to a short question on frequency of intake of BF cereal reported a frequency consistent with that recorded by dietary record.
- The extent of error reporting seems unaffected by population subgroup except for analysis by season. Frequency response by SQ was lower in summer and higher in autumn while frequency response by WR was unaffected by season.

### **Indirect validity**

*incr in fibre, thiamine, CHO p<0.001*

*eg fibre*

<i>Rarely/never</i>	<i>17.4 g/d</i>
<i>1/mt-&lt;2/wk</i>	<i>18.1 g/d</i>
<i>2/wk-&lt;7/wk</i>	<i>21.4 g/d</i>
<i>≥7/wk</i>	<i>24.8 g/d</i>
	<i>p&lt;0.001</i>

- Positive association between reported frequency of consumption of BF cereal and mean daily intakes of total and as %E of dietary fibre, thiamine and CHO.
- Energy was not significant
- Spearman correlation coefficients were generally fair at approx 0.3.

**C. How often do you eat pasta, rice, noodles or other cooked cereals? (not including cooked BF cereal)**

Comments: useful as indicator of pasta/rice intake as a component of B&C.

Cooked cereals are consumed less frequency than bread by the study population. In general, the response to the short question on cooked cereal consumption was distributed in a similar way in the population subgroups examined although there appeared to be a trend to lower reported consumption in the older age group, in the group with higher BMI and in groups of lower SES.

**Direct validity:**

Short question (reported) compared to recorded 3-day WR

	Daily freq (exp freq)	Quantity	Recorded intake
Rarely/never	0.09 (<0.03)	23 g/d	77% no intake
1/mt-<2/wk	0.2 (0.03-<0.28)	46 g/d	58% no intake
2/wk-<7/wk	0.36 (0.28-<1.0)	75 g/d	33% no intake
≥7/wk	0.46 (≥1.0)	99 g/d	29% no intake
	p<0.001	p<0.001	

- Positive association between reported frequency of consumption and average daily weight of cooked cereal consumed.
- Men had a higher average daily weight of cooked cereal intake than women
- Positive association between reported frequency of consumption and mean daily frequency of cooked cereal intake (Spearman cc 0.39 for men and 0.33 for women)
- Cooked cereal intake is overestimated by SQ at the highest estimate of intake (cf observed frequency (WR) 0.46 to expected frequency of ≥1.0.)
- Cooked cereal intake was underestimated by SQ at the lowest estimate of intake (cf observed frequency (WR) 0.09 to expected frequency of <0.03).
- The mean WR/SQ (recorded mean frequency minus reported mean frequency) was -0.02 (95% CI -0.04 to 0.01) suggesting that on average, subjects responding to a short question on frequency of intake of cooked cereal reported a frequency consistent with that recorded by dietary record.
- The extent of error reporting seems unaffected by population subgroup except for analysis by season. There was a tendency for subjects to eat cooked cereals less frequently in summer than winter.

**Indirect validity**

incr in fibre p<0.001; incr in CHO p<0.01; thiamine p=0.03, eg fibre

Rarely/never	18.4 g/d
1/mt-<2/wk	19.7
2/wk-<7/wk	22.3
≥7/wk	23.4
	p<0.001

- Positive association between reported frequency of consumption of cooked cereal and mean daily intakes of total and as %E of dietary fibre and CHO.
- Spearman correlation coefficients were modest (0.10-0.20).

## APPENDIX 2

### Further subgroup analysis by age categories.

#### **A. Bread** (Table 1A)

Further analysis of subgroups by age reveals that the weighted kappa is generally lowest (0.43-0.48) in the >55 years age groups. The age group with the highest level of agreement was the 35-54 year age group (weighted kappas ranged from 0.48-0.59). Weighted kappas of 0.40-0.60 are considered to have 'moderate agreement'.

#### **B. Breakfast cereal** (Table 2A)

Further analysis of subgroups by age reveals that the weighted kappa was lowest (0.66-0.74) in the <35 years age group for all subgroups analysed. However, this level of agreement is still considered to be 'good agreement' (Altman, 1991).

#### **C. Cooked cereal** (Table 3A)

Further analysis of subgroups by age does not reveal major differences in weighted kappas among the different age groups.

Table 1A. Subgroup analysis by age for bread intake: weighted kappas

Subgroup	n	Weighted kappa	A. Std Error
<b>Male: Age&lt;35y</b>	356	0.50	0.033
<b>Age 35-54y</b>	586	0.48	0.027
<b>Age&gt;55y</b>	802	0.43	0.025
<b>Female: Age&lt;35 y</b>	461	0.52	0.032
<b>Age 35-54y</b>	769	0.59	0.023
<b>Age&gt;55y</b>	1096	0.43	0.020
<b>BMI&lt;25.0: Age&lt;35y</b>	499	0.55	0.028
<b>Age 35-54y</b>	605	0.56	0.026
<b>Age&gt;55y</b>	850	0.44	0.024
<b>BMI25.0-29.9: Age&lt;35y</b>	176	0.55	0.051
<b>Age 35-54y</b>	453	0.55	0.029
<b>Age&gt;55y</b>	635	0.42	0.028
<b>BMI&gt;30.0: Age&lt;35y</b>	97	0.40	0.069
<b>Age 35-54y</b>	244	0.54	0.041
<b>Age&gt;55y</b>	321	0.48	0.038
<b>SEIFAcacat1: Age&lt;35y</b>	194	0.65	0.042
<b>Age 35-54y</b>	296	0.56	0.036
<b>Age&gt;55y</b>	355	0.47	0.035
<b>SEIFAcacat3: Age&lt;35y</b>	208	0.50	0.047
<b>Age 35-54y</b>	282	0.56	0.037
<b>Age&gt;55y</b>	361	0.43	0.037
<b>SEIFAcacat4: Age&lt;35y</b>	219	0.50	0.043
<b>Age 35-54y</b>	403	0.55	0.031
<b>Age&gt;55y</b>	587	0.39	0.029
<b>SEIFAcacat5: Age&lt;35y</b>	196	0.49	0.048
<b>Age 35-54y</b>	374	0.55	0.033
<b>Age&gt;55y</b>	595	0.47	0.028
<b>ARIAcat1: Age&lt;35y</b>	583	0.56	0.026
<b>Age 35-54y</b>	853	0.57	0.021
<b>Age&gt;55y</b>	1113	0.45	0.021
<b>ARIAcat2: Age&lt;35y</b>	143	0.37	0.059
<b>Age 35-54y</b>	344	0.51	0.035
<b>Age&gt;55y</b>	571	0.42	0.029
<b>ARIAcat3: Age&lt;35y</b>	76	0.66	0.058
<b>Age 35-54y</b>	144	0.53	0.056
<b>Age&gt;55y</b>	197	0.43	0.052

**Table 2A. Subgroup analysis by age for breakfast cereal intake: weighted kappas**

<b>Subgroup</b>	<b>n</b>	<b>Weighted kappa</b>	<b>A. Std Error</b>
<b>Male: Age&lt;35y</b>	360	0.66	0.023
<b>Age 35-54y</b>	606	0.74	0.017
<b>Age&gt;55y</b>	773	0.76	0.016
<b>Female: Age&lt;35 y</b>	490	0.75	0.019
<b>Age 35-54y</b>	762	0.79	0.015
<b>Age&gt;55y</b>	1177	0.79	0.014
<b>BMI&lt;25.0: Age&lt;35y</b>	517	0.69	0.020
<b>Age 35-54y</b>	620	0.77	0.016
<b>Age&gt;55y</b>	849	0.78	0.016
<b>BMI25.0-29.9: Age&lt;35y</b>	379	0.72	0.031
<b>Age 35-54y</b>	437	0.74	0.022
<b>Age&gt;55y</b>	655	0.79	0.018
<b>BMI&gt;30.0: Age&lt;35y</b>	91	0.74	0.041
<b>Age 35-54y</b>	254	0.83	0.024
<b>Age&gt;55y</b>	340	0.77	0.023
<b>SEIFAcats: Age&lt;35y</b>			
<b>Age 35-54y</b>	204	0.72	0.030
<b>Age&gt;55y</b>	282	0.74	0.026
<b>SEIFAcats: Age&gt;55y</b>	351	0.81	0.023
<b>SEIFAcats: Age&lt;35y</b>	204	0.72	0.030
<b>Age 35-54y</b>	313	0.74	0.026
<b>Age&gt;55y</b>	359	0.78	0.024
<b>SEIFAcats: Age&lt;35y</b>	254	0.69	0.027
<b>Age 35-54y</b>	419	0.80	0.019
<b>Age&gt;55y</b>	644	0.77	0.018
<b>SEIFAcats: Age&lt;35y</b>	188	0.70	0.033
<b>Age 35-54y</b>	354	0.79	0.021
<b>Age&gt;55y</b>	596	0.77	0.019
<b>ARIAcats: Age&lt;35y</b>	575	0.72	0.018
<b>Age 35-54y</b>	819	0.75	0.015
<b>Age&gt;55y</b>	1066	0.78	0.014
<b>ARIAcats: Age&lt;35y</b>	192	0.68	0.030
<b>Age 35-54y</b>	378	0.82	0.020
<b>Age&gt;55y</b>	625	0.77	0.019
<b>ARIAcats: Age&lt;35y</b>	74	0.71	0.052
<b>Age 35-54y</b>	158	0.78	0.032
<b>Age&gt;55y</b>	239	0.81	0.026

Table 3A. Subgroup analysis by age for cooked cereal intake: weighted kappas

Subgroup	n	Weighted kappa	A. Std Error
Male: Age<35y	350	0.75	0.031
Age 35-54y	576	0.72	0.026
Age>55y	800	0.73	0.020
Female: Age<35 y	490	0.75	0.026
Age 35-54y	836	0.75	0.020
Age>55y	1089	0.72	0.019
BMI<25.0: Age<35y	501	0.79	0.024
Age 35-54y	639	0.72	0.024
Age>55y	812	0.71	0.021
BMI25.0-29.9: Age<35y	197	0.71	0.045
Age 35-54y	443	0.76	0.028
Age>55y	675	0.71	0.024
BMI>30.0: Age<35y	94	0.62	0.067
Age 35-54y	262	0.71	0.037
Age>55y	325	0.76	0.031
SEIFAcats: Age<35y	210	0.71	0.046
Age 35-54y	318	0.71	0.036
Age>55y	344	0.72	0.033
SEIFAcats: Age<35y	207	0.75	0.040
Age 35-54y	285	0.75	0.034
Age>55y	394	0.73	0.030
SEIFAcats: Age<35y	234	0.76	0.035
Age 35-54y	450	0.71	0.029
Age>55y	608	0.71	0.025
SEIFAcats: Age<35y	189	0.76	0.041
Age 35-54y	359	0.77	0.029
Age>55y	543	0.74	0.026
ARIAcats: Age<35y	576	0.75	0.024
Age 35-54y	851	0.73	0.021
Age>55y	1064	0.72	0.019
ARIAcats: Age<35y	171	0.70	0.050
Age 35-54y	368	0.73	0.030
Age>55y	560	0.72	0.026
ARIAcats: Age<35y	84	0.84	0.048
Age 35-54y	179	0.76	0.041
Age>55y	248	0.78	0.033

## APPENDIX 3

*For daily consumers:*

**Table 4A. All: Crosstab of frequency and quantity of bread consumption**

		Frequency categories			Total	
		1/day	>1-<2/day	>2/day		
Quantity of bread	1-2 slices	Count	1040	229	21	1290
		% within daf3bacat	66.4%	15.4%	5.2%	37.2%
	>2-4slices	Count	440	961	113	1514
		% within daf3bacat	28.1%	64.5%	27.8%	43.7%
	>4slices	Count	86	301	273	660
		% within daf3bacat	5.5%	20.2%	67.1%	19.1%
Total		Count	1566	1491	407	3464
		% within daf3bacat	100.0%	100.0%	100.0%	100.0%

Weighted kappa: 0.50 (ASE 0.013)

**Table 5A. Males: Crosstab of frequency and quantity of bread consumption**

		Frequency categories			Total	
		1/day	>1-<2/day	>2/day		
Quantity of bread	1-2 slices	Count	319	77	9	405
		% within daf3bacat	51.6%	11.5%	3.6%	26.4%
	>2-4 slices	Count	235	351	46	632
		% within daf3bacat	38.0%	52.6%	18.6%	41.3%
	>4slices	Count	64	239	192	495
		% within daf3bacat	10.4%	35.8%	77.7%	32.3%
Total		Count	618	667	247	1532
		% within daf3bacat	100.0%	100.0%	100.0%	100.0%

Weighted kappa: 0.42 (ASE 0.019)

**Table 6A. Females: Crosstab of frequency and quantity of bread consumption**

		Frequency categories			Total	
		1/day	>1-<2/day	>2/day		
Quantity of bread	1-2 slices	Count	721	152	12	885
		% within daf3bacat	76.1%	18.4%	7.5%	45.8%
	>2-4 slices	Count	205	610	67	882
		% within daf3bacat	21.6%	74.0%	41.9%	45.7%
	>4 slices	Count	22	62	81	165
		% within daf3bacat	2.3%	7.5%	50.6%	8.5%
Total		Count	948	824	160	1932
		% within daf3bacat	100.0%	100.0%	100.0%	100.0%

Weighted kappa: 0.56 (ASE 0.017)

***Infrequent consumers of bread***

**Table 7A: Crosstab of frequency and quantity of bread consumption**

		Frequency categories			Total	
		<1/week	2/week	>3/day		
Quantity of bread	1-2 slices	Count	28	24	3	55
		% within daf3bbcat	84.8%	34.8%	3.3%	28.5%
	>2-4slices	Count	5	38	47	90
		% within daf3bbcat	15.2%	55.1%	51.6%	46.6%
	>4slices	Count	0	7	41	48
		% within daf3bbcat	.0%	10.1%	45.1%	24.9%
Total		Count	33	69	91	193
		% within daf3bbcat	100.0%	100.0%	100.0%	100.0%

Weighted kappa 0.45

## APPENDIX 4

### Comparison of the NSW Health Survey 2002 to the 1996 NHMRC dietary key indicators study.

The purpose of this section is to compare the reported results on bread and cereal intake from the NSW Health Survey 2002 with the results from the 1996 NHMRC Dietary Key Indicators Study (referred to as the Tasmanian survey)(Riley et al, 2001). The Tasmanian survey included short questions on frequency of bread and cereal intake, as well as 3-day weighed dietary records.

#### (A) Bread intake

The frequency of bread consumption data is similar between the NSW and Tasmanian surveys (Table 8A).

**Table 8A. Comparison of frequency of bread consumed: NSW and Tasmanian surveys**

Frequency	All		Males		Females	
	NSW	Tasmania	NSW	Tasmania	NSW	Tasmania
0- <1/d	13.7%	14.9%	11.1%	12.8%	15.5%	16.7%
1- <2/d	38.9%	38.9%	35.7%	38.6%	41.2%	39.2%
2- <3/d	36.4%	37.9%	37.7%	37.5%	35.4%	38.3%
≥3/d	11.1%	8.3%	15.6%	11.5%	7.8%	5.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
n	12466	794	5253	368	7213	426

**Table 9A: Comparison of quantity of bread consumption (per day): NSW and Tasmanian surveys**

Frequency	All			Males			Females		
	NSW	Tasmania	Tasmania	NSW	Tasmania	Tasmania	NSW	Tasmania	Tasmania
	slices	grams*	grams**	slices	grams*	grams**	slices	grams*	grams**
0- <1/d	1.2	35	69	1.5	46	80	0.96	29	62
1- <2/d	2.5	76	109	3.0	89	126	2.2	67	94
2- <3/d	3.9	116	135	4.4	133	157	3.4	103	116
≥3/d	5.7	169	161	6.3	190	192	4.6	138	112

\*grams of bread (mean) are calculated assuming 1 slice of bread weighs 30 grams, and slices were estimated by short question (NSW Health Survey 2002)

\*\* grams of bread (mean) measured using weighed food records (Tasmanian survey)

Table 9A illustrates an attempt to compare the quantities of bread consumed (according to frequency) between the two surveys. Both surveys used the short question on frequency of bread consumption —the NSW survey used the short question on quantity of bread consumption to estimate intake (grams per day), whereas the Tasmanian survey used data from their weighed dietary records. Consequently, the Tasmanian data on bread consumption is likely to be more accurate. Although the comparison methods are fairly crude, Table 9A suggests that the daily quantity of bread consumed in NSW is lower, and may be underreported, when the frequency of intake is less than three times per day compared to the Tasmanian results.

On the other hand, the validity results of the Tasmanian survey (SQ vs WFR) show that people tend to overestimate the frequency of bread intake (by SQ) at the higher estimates of intake (twice a day or more) compared to weighed dietary records.

### **(B) Breakfast cereal intake**

Table 10A compares the frequency of breakfast cereal consumption (as reported by short question) between the NSW and Tasmanian surveys. NSW respondents reported a higher frequency of consumption, with 49.0% consuming breakfast cereal at least once a day compared to 38.0% by Tasmanian respondents.

**Table 10A. Comparison of frequency of breakfast cereal consumption: NSW and Tasmanian surveys**

Frequency	All		Males		Females	
	NSW	Tasmania	NSW	Tasmania	NSW	Tasmania
Rarely	26.6%	27.9%	27.3%	26.2%	26.2%	29.3%
1/m-<2/w	6.6%	10.1%	6.3%	10.4%	6.8%	9.9%
2/w-<1/d	17.8%	24.1%	17.3%	25.3%	18.2%	23.0%
≥1/d	49.0%	38.0%	49.1%	38.1%	48.9%	37.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
n	12457	793	5260	367	7205	426

**Table 11A: Comparison of quantity of breakfast cereal consumption (per day): NSW and Tasmanian surveys**

Frequency	All		Males			Females			
	NSW		Tasmania	NSW		Tasmania	NSW		Tasmania
	cups	grams*	grams**	cups	grams*	grams**	cups	grams*	grams**
Rarely	.01	0.3-1	3	.00	0	4	.01	0.3-1	2
1/m-<2/w	.16	5-16	10	.15	5-15	10	.17	5-17	11
2/w-<1/d	.76	23-76	36	.81	24-81	39	.73	22-73	34
≥1/d	1.26	38-126	63	1.45	44-145	72	1.12	34-112	55

\*grams of breakfast cereal (mean) are calculated assuming the weight of 1 cup of breakfast cereal ranges between 30 g (cornflakes, puffed wheat, weeties) and 100 grams (muesli, porridge). Serves (cups) were estimated by short question (NSW Health Survey 2002)

\*\* grams of breakfast cereal (mean) measured using weighed food records (Tasmanian survey)

Table 11A illustrates a crude comparison of the quantities of breakfast cereal consumed between the two surveys. Both surveys used the short question on frequency of breakfast cereal consumption —the NSW survey used the short question on quantity of breakfast cereal consumption to estimate intake (cups per day converted to grams per day), whereas the Tasmanian survey used data from their weighed dietary records. Consequently, the Tasmanian data on breakfast cereal consumption is likely to be more accurate. Although the comparison methods are indirect, Table 11A suggests that the consumption of breakfast cereal in the Tasmanian survey is within the range of breakfast cereal consumed in NSW.

The results of the Tasmanian validation study show that people tend to overestimate the frequency of breakfast cereal intake (by SQ) at the higher estimate of intake and underestimate at the lowest estimate of intake compared to weighed dietary records.

### **(C) Cooked cereal intake**

Table 12A shows the frequency of cooked cereal consumption (as reported by short question) to be quite similar between the NSW and Tasmanian surveys.

**Table 12A. Comparison of frequency of cooked cereal consumption: NSW and Tasmanian surveys**

Frequency	All		Males		Females	
	NSW	Tasmania	NSW	Tasmania	NSW	Tasmania
Rarely	9.5%	8.3%	11.6%	10.1%	8.0%	6.8%
1/m-<2/w	25.5%	32.9%	27.5%	34.8%	24.0%	31.2%
2/w-<1/d	55.0%	52.6%	51.5%	49.7%	57.5%	55.2%
≥1/d	10.0%	6.2%	9.4%	5.4%	10.5%	6.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
n	12440	794	5238	368	7231	426

**Table 13A: Comparison of quantity of cooked cereal consumption (per day): NSW and Tasmanian surveys**

Frequency	All			Males			Females		
	NSW	Tasmania	Tasmania	NSW	Tasmania	Tasmania	NSW	Tasmania	Tasmania
	cups	grams*	grams**	cups	grams*	grams**	cups	grams*	grams**
Rarely	0.03	4-5	22	0.04	6-7	18	0.03	4-5	28
1/m-<2/w	0.18	27-32	46	0.19	29-34	51	0.17	26-31	41
2/w-<1/d	0.53	80-95	75	0.52	79-94	84	0.53	79-95	67
≥1/d	1.27	191-229	99	1.36	204-244	125	1.21	181-218	80

\*grams of cooked cereal (mean) are calculated assuming the weight of 1 cup of cooked cereal ranges between 150 g (pasta) and 180 grams (rice). Serves (cups) were estimated by short question (NSW Health Survey 2002)

\*\* grams of cooked cereal (mean) measured using weighed food records (Tasmanian survey)

Table 13A illustrates a crude comparison of the quantities of cooked cereal consumed between the two surveys. Both surveys used the short question on frequency of cooked cereal consumption—the NSW survey used the short question on quantity of cooked cereal consumption to estimate intake (cups per day converted to grams per day), whereas the Tasmanian survey used data from their weighed dietary records. Consequently, the Tasmanian data on cooked cereal consumption is likely to be more accurate. Although the comparison methods are indirect, Table 13A suggests that the consumption of cooked cereal in the Tasmanian study seems to be higher (ie higher quantity) when consumed less frequently (<2/w) compared to the NSW data but consumption is lower (ie lower quantity) when consumed more frequently (≥2/w).

The results of the Tasmanian validation study show that people tend to overestimate the frequency of cooked cereal intake (by SQ) at the higher estimate of intake and underestimate at the lowest estimate of intake compared to weighed dietary records.

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