European Journal of Clinical Nutrition (2008) 62, 356–364
 0954-3007/08 $30.00
www.nature.com/ejcn

ORIGINAL ARTICLE

Consumption of 'extra' foods by Australian children: types, quantities and contribution to energy and nutrient intakes

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Objective: To measure the types and quantities of energy-dense, nutrient-poor 'extra' foods consumed by Australian children and adolescents and their contribution to total energy and nutrient intakes.
Design, setting and subjects: We used data from 3007 children, aged 2–18 years, who participated in the nationally representative 1995 National Nutrition Survey. Intake was determined by 24-h recall and 'extra' foods were defined using principles outlined in the Australian Guide to Healthy Eating (AGHE) and by applying cut points for maximum amounts of fat and sugar within each food category.
Results: All children (99.8%) consumed at least one 'extra' food and the most commonly consumed were margarine, sugar-sweetened soft drinks, cordials and sugar. 'Extra' foods contributed 41% of daily energy intake. Those foods contributing most to energy intake were fried potatoes (4.2%), sugar-sweetened soft drinks (3.3%), ice cream/ice confection (3.1%) and cordials (2.7%). Age and sex were important determinants of 'extra' food intake, with males and older children generally consuming more and different types of, 'extra' foods than females and younger children. 'Extra' foods contributed 19% protein, 47% total fat, 47% saturated fat, 54% sugar, and approximately 20–25% of selected micronutrients to the diet. Calcium and zinc intakes from core foods were below 70% of the recommended dietary intakes for adolescent girls.
Conclusions: 'Extra' foods are over-consumed at two to four times the recommended limits and contribute excessively to the energy, fat and sugar intakes of Australian children, while providing relatively few micronutrients. This is of concern in terms of children's weight and nutrient status.
Sponsorship: DR was on placement at NSW Centre for Public Health Nutrition as part of the NSW Health Biostatistical Officer Trainee Program.
European Journal of Clinical Nutrition (2008) **62,** 356–364; doi:10.1038/sj.ejcn.1602720; published online 14 March 2007

Keywords: child nutrition; adolescent nutrition; energy intake; food habits; nutrition surveys; Australia

Introduction

The consumption of energy-dense, nutrient-poor foods is of public health concern. These foods contribute few micronutrients to the diet, but contain substantial amounts of fat and/or sugar and are high in energy. Patterns of consumption of such foods may contribute to excessive energy intakes and unwanted weight gain in children (Swinburn *et al.*, 2004), and replace more nutritious foods, leading to marginal intakes of some micronutrients (Kant 2003; Webb *et al.*, 2006).

There is no widely accepted term to cover energy-dense, nutrient-poor foods, nor consensus about which foods should be included in this category (Bell *et al.*, 2005; Drewnowski, 2005; Webb *et al.*, 2006). Food selection guides in various countries refer to and deal with these foods in different ways. For example, the Australian Guide to Healthy Eating (AGHE) classifies foods as either core or 'extra' (Smith

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Contributors: AMR interpreted the data and wrote the initial draft of the paper. DR analysed the data. KLW contributed to the original concept of analysing 'extra' food consumption and she, TPG and DJH provided assistance in interpreting the data and contributed to the manuscript writing.
Received 16 October 2006; revised 18 January 2007; accepted 5 February 2007; published online 14 March 2007

et al., 1998). Core foods are those comprising the five food groups – cereals, fruit, vegetables, meat and alternatives and the milk group. The AGHE describes 'extra foods' as 'foods that do not fit into the five main groups' and 'are not essential to provide the nutrients the body needs'. It also advises that 'extra' foods be limited in consumption to 'sometimes' (e.g. hot chips, confectionery, soft drinks) or 'in small amounts' (e.g. margarine, cooking oils). An acceptable limit of 'extra' foods has been calculated for various age groups as 1–2 serves for children aged 4–11 years and 1–3 serves for 12–18 year olds. A serve has been defined as the amount of food containing 600 kJ. This allowance is estimated to provide between 5 and 20% of daily energy intake for children aged 4–18 years.

Information about the types and amounts consumed of all 'extra' foods and their contribution to children's diets would enable the development of rational policies and programmes that may prevent childhood obesity, and guide public health programs aiming to promote optimal nutritional status among children and adolescents. Internationally, there have been many studies of the intakes of selected 'extra' foods, but few studies have investigated the cumulative intake of these foods and their contribution to the total intake of energy and nutrients. One such study investigated the consumption of 'extra' foods among a relatively large sample of Australian toddlers and showed that these foods contributed nearly one-third of their total energy intakes, but considerably less to their micronutrient intakes (Webb *et al.*, 2006). Another study, based on data from the 1995 National Nutrition Survey (NNS) for 2–18 year olds found energy intake from total 'extra' foods to be high at 41% (Bell *et al.*, 2005).

In this paper, we report detailed information on the consumption of 'extra' foods among Australian children aged 2–18 years. Using data from the 1995 NNS, we describe the types and quantities of the most commonly consumed 'extra' foods, and their contribution to total energy and nutrient intakes. We also compare the nutrient contributions made by core foods and 'extra' foods in relation to the recommended dietary intakes (RDIs) for Australian children, and assess the role of 'extra' foods in meeting the RDIs (NHMRC, 1991). Although the NNS was undertaken over 10 years ago, it provides the latest nationally representative dietary data in Australia. Data from this survey give an indication of the role of 'extra' foods relative to core foods in children's diets and will serve as a useful comparison for future surveys.

Methods

1995 NNS

The details of the sampling frame, data collection methods and response rates for the NNS have been reported previously (McLennan and Podger, 1998). In brief, the NNS was conducted on a systematic sub-sample of those selected for the 1995 National Health Survey (NHS). The sample frame for the NHS was a multistage probability sample of private and non-private dwellings and for the NNS, a subsample of households were selected from private dwellings, in which individuals aged 2 years and older were selected for the nutrition survey. The response rate for the NNS was 61.4% of eligible participants, with a total of 3007 respondents aged 2–18 years.

Detailed food consumption data were collected using a structured 24-h recall interview to identify foods and beverages consumed by participants on the day before the interview (McLennan and Podger, 1998). The interviews were conducted in three phases by qualified nutritionists: (i) the completion of a quick list of foods and beverages consumed during the 24 h period; (ii) collection of detailed information about types, brands, preparation methods and quantities for each food and drink item listed in the quick list; and (iii) a recall-review to allow respondents to report any foods or details that may have been forgotten. Proxy interviews were conducted for children aged 2–4 years with the preferred proxy being the person responsible for preparing the child's meals. Children aged 5–11 years old provided their own food intake data with the assistance of a household member, whereas those aged 12 or older reported their own intakes. Nutrient intakes for each respondent were calculated using AUSNUT 1997, a food composition database compiled specifically for the NNS, containing information about the energy and nutrient content of over 4000 Australian foods.

Data on consumption of foods and nutrients for all children and adolescents aged 2–18 years were included in this secondary analysis and were obtained from the Confidentialized Unit Record Files supplied by the Australian Bureau of Statistics. Each food and beverage reported in the 24-h recall has been assigned a unique eight-digit food code; with the first two digits identifying the broad food grouping and each subsequent digit leading to the identification of the specific food item.

Classification of 'extra' foods

A hierarchy of steps was undertaken to classify 'extra' foods. Examples of 'extra' foods listed in the AGHE, such as biscuits, cakes, soft drinks, ice cream, pies, hot chips and high fat take-away items and chocolate, provided the basis of the classification system. The fat and sugar contents of these 'example' foods were examined to identify cut points to differentiate 'extra' foods from core foods within each food category at the three-digit or four-digit level. These cut points were then applied to the individual food and beverage items (eight-digit level). For example, cakes are identified as 'extras' in the AGHE, and these contain on average more than 15 g of fat and 20 g of sugar per 100 g, hence the cut points were set at 15 and 20% for fat and sugar content, respectively. Foods within the 'cakes, buns, muffins, scones' category' that exceed these cut points were classified as 'extra' foods. The AUSNUT database (Special Edition 3,

February 2004) was used to ascertain the fat and sugar content of all food items on the NNS database, consumed by the survey participants.

To determine the commonly consumed food items, we grouped like items such as hot chips, fries, wedges, hash browns, potato scallops, potato gems and potato patties, and classified these as 'fried potatoes'. 'Sugar-sweetened soft drinks' included soft drinks, cola; soft drinks, non-cola; and flavoured mineral waters but not artificially sweetened soft drinks.

Core foods included most cereal products (including all breakfast cereals); cereal-based products low in fat; most meat, fish, poultry and egg products or dishes (except for those very high in fat); seeds; nuts; legumes; most dairy products (except cream, ice cream); most fruit and vegetables (except fried potatoes), fruit juices; soups; pasta and simmer sauces; yeast extracts and water. All other foods were classified as 'extra' foods, for example sweet biscuits, cakes, high fat savoury biscuits, garlic bread, pastries, pies, quiche, salami, hamburgers, pizza, fried potatoes, crisps, fat spreads, oils, confectionery, soft drinks, fruit drinks, cordials and alcohol. A detailed list of core and 'extra' foods can be found on the following website: www.cphn.mmb.usyd.edu.au.

Contribution of 'extra' foods to nutrient intakes

The contribution of core and 'extra' foods to total nutrient intakes from the overall diet, in relation to the RDIs for Australians, was determined. For each age and sex category the lower RDI was chosen, with the exception of protein for which the midpoint was chosen (Cashel and Jefferson, 1992).

Statistical analysis

Analyses were conducted on the children's sub-set of the NNS database, that is, aged 2–18 years ($n = 3007$), and subgroups of children based on sex and age group (as reported in the NNS; 2–3, 4–7, 8–11, 12–15, 16–18 years). Analyses were performed using SPSS Version 12.0 software (SPSS Inc., 1989–2003), SAS software Version 8 and Version 9 (SAS Institute Inc., 1999–2001).

Table 1 Commonly consumed 'extra' foods among 3007 Australian children aged 2–18 years; percent consuming, mean intake per capita and per consumer, and percentage energy contribution, 1995 National Nutrition Survey

'Extra' food type	*Percent consuming*	*Test for trend by age group (P-value)*	*Mean intake per capita (g/day)*	*Mean intake per consumer (g/day)*	*Rank (% energy contribution)*
Margarine	61.8	↓ <0.0001	7.3	11.8	6 (2.5%)
Sugar-sweetened soft drinks	35.4	↑ <0.0001	180.7	511.1	2 (3.3%)
Cordials	35.4	↓ <0.0001	119.3	337.2	4 (2.7%)
Sugar	34.6	0.998	3.2	9.2	
Sweet biscuits	31.1	↓ <0.0001	10.4	33.2	7 (2.4%)
Ice cream/ice confection	30.0	0.762	41.3	137.6	3 (3.1%)
Chocolate/chocolate bars	26.8	0.560	10.6	39.7	9 (2.2%)
Fried potatoes	25.0	↑0.005	36.3	144.9	1 (4.2%)
Beverage flavourings	22.0	↓0.0002	1.5	6.7	
Lollies and confectionery	20.2	↓ <0.0001	5.6	28.0	
Fruit drinks	18.9	↓0.0019	71.8	380.6	11 (1.4%)
Potato crisps	17.5	0.870	6.0	34.4	10 (1.5%)
Cakes and muffins	17.3	0.298	15.8	91.6	8 (2.3%)
Savoury biscuits – high fat	16.1	↓ <0.0001	4.5	27.9	
Butter and dairy fats	15.9	0.155	7.3	10.6	
Muesli and fruit bars	14.4	↓ <0.0001	4.5	31.7	
Tea and coffee	14.1	↑ <0.0001	50.9	361.0	
Jam and conserves	13.2	↓0.001	1.9	14.6	
Meat pies and savoury pastries	12.7	↑0.002	22.6	177.5	5 (2.6%)
Salad dressings	10.8	↑ <0.0001	1.8	16.5	
Tomato and BBQ sauce	10.5	↑ <0.0001	3.0	28.4	
Honey and sugar syrups	9.5	↓0.0004	1.6	16.7	
Ice blocks and sorbet	8.3	↓0.0003	9.2	110.4	
Extruded snacks	8.1	0.333	2.5	30.7	
Pizza	7.4	↑ <0.0001	11.6	156.0	12 (1.3%)
Gravies	7.3	↑0.007	5.0	68.7	
Toppings	6.9	0.739	3.1	44.3	
Corn chips and popcorn	6.5	0.329	2.2	34.3	
Diet soft drinks	6.4	↑0.0002	24.4	378.9	
Hamburgers/chicken burgers	6.0	↑0.0002	10.0	165.4	
Sweet pies and pastries	5.9	↑ <0.0001	6.9	117.2	
Chocolate spreads	5.6	↓ <0.0001	0.8	14.0	
All 'extra' foods (including those consumed by <5% of 2–18 years olds)	99.8	0.331	725.3	726.9	40.9%

The per cent consuming, mean intake among consumers and average per cent contribution to daily intake of the more commonly consumed 'extra' foods were derived and were weighted to the population to allow for under-enumeration and non-participation.

Two-sided Cochran–Armitage tests for trend were conducted to determine if there were trends across age groups in the per cent consuming specific 'extra' foods (Table 1). Odds ratios were calculated from the per cent consuming data and represent the odds of consuming each food type in the older age groups against the per cent consuming in the 2–3-year age group (Table 2). As it was possible to have more than one person per household in the sample, the confidence limits took into account the effect of clustering.

Analysis of variance (ANOVA) was used to compare the mean intake per consumer per day across the age groups and by sex (Table 3). Per-consumer data were used instead of per-capita data because the percentage consuming a particular food item was generally small, which resulted in very skewed per-capita intake data and a zero median value. ANOVA was also used to compare the average per cent contribution of all 'extra' foods to the daily intake of various nutrients by age group (Table 4). A linear contrast was included and reported on to test whether there was a trend by age group. The ANOVA models also took into account the effect of clustering on the error around the estimates.

Ninety-five per cent confidence limits around percentage and mean estimates, calculated accounting for clustering, were used to judge whether specific differences between male and female subjects within age groups were significant.

Results

Of a total of 2649 food items consumed by survey participants in the 24 h before the survey, 942 were classified as 'extra' foods. The most commonly consumed 'extra' food items, those consumed by more than 5% of children, are listed in Table 1. Also shown are the quantities consumed and their contribution to average energy intake for foods that contributed more than 1% to daily energy intake. Nearly all participants (99.8%) consumed at least one 'extra' food. Margarine was the most commonly consumed 'extra' food type, followed by sugar-sweetened soft drinks, cordials and sugar, all of which were consumed by over one-third of participants in the 24-h recall.

Several 'extra' foods were consumed in relatively large amounts and made a substantial contribution to energy intake. Foods that contributed most to energy intake (i.e. more than 1% of daily energy intake) are ranked in Table 1 and include fried potatoes (4.2%), sugar-sweetened soft drinks (3.3%), ice cream/ice confection (3.1%) and cordials

Table 2 Odds ratios (95% CIs) for per cent consuming particular 'extra' foods by age group, among Australian children; 1995 NNS

'Extra' food type	*OR (95% CIs) for per cent consuming*				
	2–3 years	*4–7 years*	*8–11 years*	*12–15 years*	*16–18 years*
Increasing % consumption with age					
Sugar-sweetened soft drinks	Reference group	1.28 (0.91–1.80)	1.54 (1.08–2.20)	2.09 (1.47–2.98)	3.33 (2.29–4.85)
Fried potatoes		1.17 (0.84–1.64)	1.34 (0.96–1.88)	1.51 (1.06–2.15)	1.42 (0.97–2.09)
Tea and coffee		0.92 (0.50–1.69)	1.39 (0.79–2.44)	2.49 (1.42–4.37)	6.09 (3.49–10.65)
Meat pies and savoury pastries		1.23 (0.78–1.94)	1.24 (0.78–1.97)	1.27 (0.79–2.04)	1.93 (1.18–3.15)
Salad dressings		1.86 (0.97–3.57)	2.32 (1.27–4.23)	3.12 (1.69–5.77)	3.86 (2.01–7.39)
Tomato and BBQ sauce		0.69 (0.38–1.26)	1.36 (0.77–2.41)	1.30 (0.73–2.32)	2.46 (1.38–4.39)
Pizza		1.97 (0.96–4.03)	2.97 (1.43–6.17)	2.90 (1.39–6.05)	3.34 (1.52–7.32)
Gravies		0.63 (0.35–1.14)	0.88 (0.49–1.58)	1.45 (0.85–2.47)	1.16 (0.61–2.22)
Diet soft drinks		2.09 (0.90–4.86)	2.51 (1.12–5.66)	2.72 (1.21–6.12)	3.54 (1.51–8.30)
Hamburgers/chicken burgers		1.44 (0.76–2.73)	1.71 (0.88–3.33)	1.77 (0.91–3.43)	2.89 (1.49–5.61)
Sweet pies and pastries		2.06 (0.90–4.68)	4.56 (1.99–10.42)	3.76 (1.61–8.75)	5.41 (2.29–12.79)
Decreasing % consumption with age					
Margarine	Reference group	1.00 (0.74–1.35)	1.04 (0.76–1.40)	0.75 (0.55–1.03)	0.49 (0.35–0.69)
Cordials		0.98 (0.73–1.31)	0.72 (0.53–0.97)	0.54 (0.40–0.75)	0.41 (0.28–0.58)
Sweet biscuits		1.19 (0.89–1.60)	0.90 (0.66–1.23)	0.63 (0.46–0.87)	0.31 (0.21–0.46)
Beverage flavourings		0.93 (0.67–1.29)	1.00 (0.72–1.40)	0.85 (0.59–1.22)	0.52 (0.34–0.79)
Lollies and confectionery		1.38 (0.98–1.94)	1.46 (1.03–2.09)	1.02 (0.70–1.48)	0.59 (0.37–0.94)
Fruit drinks		1.03 (0.72–1.49)	0.92 (0.64–1.33)	0.88 (0.61–1.29)	0.61 (0.39–0.96)
Savoury biscuits – high fat		1.12 (0.78–1.61)	0.88 (0.59–1.29)	0.59 (0.39–0.90)	0.34 (0.20–0.58)
Muesli and fruit bars		1.35 (0.91–1.99)	1.30 (0.86–1.96)	0.83 (0.53–1.30)	0.36 (0.20–0.63)
Jam and conserves		0.78 (0.53–1.15)	0.75 (0.50–1.13)	0.71 (0.46–1.10)	0.47 (0.27–0.82)
Honey and sugar syrups		1.03 (0.67–1.61)	0.71 (0.43–1.17)	0.64 (0.38–1.06)	0.57 (0.32–1.03)
Ice blocks and sorbet		1.41 (0.84–2.36)	0.84 (0.47–1.48)	0.48 (0.24–0.96)	—
Chocolate spreads		1.92 (1.00–3.72)	1.77 (0.90–3.46)	0.65 (0.31–1.33)	—

Abbreviations: CI, confidence interval; ORs, odds ratio; NNS, National Nutrition Survey.

Table 3 Mean amounts (g per consumer per day) of the 12 'extra' foods that contribute most to energy intake among Australian children, by age and sex; 1995 NNS

'Extra' food type	*Per consumer (g/day)*								
	2–3 years	*4–7 years*	*8–11 years*	*12–15 years*		*16–18 years*		*Significance of ANOVA (P-value)*	
	All	*All*	*All*	*Males*	*Females*	*Males*	*Females*	*Age*	*Sex*
Fried potatoes	92.5	115.6	140.7	196.5	140.0	194.0	132.8	<0.0001	<0.0001
Sugar-sweetened soft drinks	222.2	336.8	458.1	635.7	500.3	836.6	545.4	<0.0001	<0.0001
Ice cream/ice confection	70.3	100.4	138.5	205.5	136.6	226.5	131.0	<0.0001	<0.0001
Cordials	248.6	321.2	327.7	517.5	301.8	418.7	285.8	0.009	0.0078
Meat pies/savoury pastries	107.0	139.6	177.0	227.2	154.9	255.0	174.1	<0.0001	0.0005
Margarine	7.7	9.6	12.7	16.6	11.8	17.7	9.1	<0.0001	<0.0001
Sweet biscuits	21.5	30.0	33.3	46.9	36.8	54.3	31.5	<0.0001	0.0022
Cakes/muffins	58.7	81.1	97.5	110.5	97.8	111.9	98.0	0.0005	0.3125
Chocolate/chocolate bars	23.4	29.2	39.3	45.8	38.6	74.7	50.7	<0.0001	0.1633
Potato crisps	27.6	31.4	31.8	38.7	36.0	48.0	36.6	0.0033	0.4985
Fruit drinks	309.1	319.4	360.0	475.6	341.1	655.3	478.9	0.0016	0.0052
Pizza	92.1	114.3	153.2	217.9	124.5	234.6	103.9	0.0005	<0.0001
All 'extra' foods	381.4	530.6	662.5	952.5	701.7	1471.7	865.5	<0.0001	<0.0001

Abbreviations: ANOVA, analysis of variance; NNS, National Nutrition Survey.

Table 4 Contribution of 'extra' foods to total intakes of energy and selected nutrients among 3007 Australian children aged 2–18 years, by age group; mean intake from total diet and per cent of daily intake from 'extra' foods, 1995 NNS

Energy or nutrient	*2–3 years*		*4–7 years*		*8–11 years*		*12–15 years*		*16–18 years*			*2–18 years*	
	Mean total intake	*% from extra foods*	*Mean total intake*	*% from extra foods*	*Mean total intake*	*% from extra foods*	*Mean total intake*	*% from extra foods*	*Mean total intake*	*% from extra foods*	*Trend for age (P-value)*	*Mean total intake*	*% from extra foods*
Energy (MJ)	6.35	33.1	7.44	40.1	9.00	42.6	10.10	42.7	11.18	42.5	<0.0001	8.95	40.9
Protein (g)	53.1	14.4	60.7	18.3	75.6	20.7	87.8	20.5	100.7	21.0	<0.0001	76.6	19.4
Total fat (g)	57.4	37.3	66.5	47.4	82.2	50.0	92.4	49.3	98.6	47.3	<0.0001	80.8	47.3
Saturated (g)	27.0	34.8	29.5	46.9	35.4	49.9	39.9	49.9	41.9	47.4	<0.0001	35.2	47.0
Monounsaturated (g)	19.2	39.6	23.0	49.2	29.0	51.0	32.7	50.1	35.2	48.0	<0.0001	28.3	48.5
Polyunsaturated (g)	6.9	45.2	8.8	50.9	11.4	53.6	12.5	51.2	13.5	49.9	0.0236	10.9	50.8
Cholesterol (mg)	168	19.9	190	25.3	241	28.7	273	27.9	320	27.5	<0.0001	241	26.5
Carbohydrates (g)	201	35.5	238	41.7	282	44.3	312	44.9	339	45.3	<0.0001	279	43.0
Sugars (g)	115	41.4	129	51.7	142	56.1	160	56.9	173	57.8	<0.0001	145	53.8
Starch (g)	84.1	26.5	108	29.8	138	31.7	151	31.3	164	31.4	0.0066	132	30.5
Fibre (g)	13.4	20.3	16.0	24.9	18.8	26.7	21.4	27.6	23.0	27.7	<0.0001	18.8	25.9
Calcium (mg)	833	12.5	769	19.0	868	22.8	943	23.8	1047	23.2	<0.0001	889	21.0
Phosphorus (mg)	1050	16.5	1111	21.8	1334	25.3	1512	25.7	1711	25.9	<0.0001	1354	23.6
Magnesium (mg)	196	17.8	214	23.1	254	26.1	285	27.0	320	28.0	<0.0001	256	25.0
Potassium (mg)	2184	17.6	2298	23.2	2672	26.1	3110	27.7	3389	27.1	<0.0001	2752	24.9
Iron (mg)	7.8	19.9	9.6	23.4	11.7	25.1	13.6	25.2	14.6	26.2	<0.0001	11.7	24.3
Zinc (mg)	6.7	14.8	7.6	19.4	9.4	21.4	11.1	21.5	12.5	21.5	<0.0001	9.6	20.2
Retinol (μg) equivalents	707	25.4	747	32.1	913	36.8	1215	34.7	1036	32.8	<0.0001	941	33.1
Thiamine (mg)	1.2	11.3	1.4	13.7	1.7	16.1	2.0	16.5	1.9	17.8	<0.0001	1.7	15.3
Riboflavin (mg)	1.9	10.5	1.9	14.8	2.2	18.1	2.5	19.5	2.4	20.8	<0.0001	2.2	17.2
Niacin (mg) equivalents	23.3	14.5	27.5	17.9	34.3	20.0	39.9	20.4	44.7	21.8	<0.0001	34.4	19.2
Folate (μg)	154	16.7	173	21.1	207	23.7	239	24.3	266	24.7	<0.0001	211	22.6
Vitamin C (mg)	102	23.3	105	25.9	111	27.0	122	27.9	140	27.0	0.067	116	26.5

Abbreviation: NNS, National Nutrition Survey.

(2.7%). Overall, 'extra' foods and beverages contributed 40.9% of energy to the diet of 2–18-year-old children – 33.1% from foods and 7.8% from beverages.

The per cent of participants consuming individual 'extra' food items varied with age – for example, the proportion of children consuming sugar-sweetened soft drinks, fried potatoes, meat pies, pizza and hamburgers increased significantly with age whereas the proportion consuming margarine, cordials, fruit drinks, sweet and savoury biscuits and lollies decreased with age (Table 2). However, the overall

per cent consuming any 'extra' food (as opposed to those consuming only core foods), did not vary with age.

The average quantities of all 'extra' foods consumed by age and sex subgroups are shown in Table 3. The quantity of 'extra' foods consumed increased significantly with age from 381 g for 2–3 year olds to 1178 g for 16–18 year olds. In the three youngest age groups, differences in intake were small between males and females, but these differences increased and became significant after the age of 12 years with males consuming greater quantities than females.

The average quantities of most of the commonly consumed 'extra' foods also varied according to age and sex (Table 3). Increased consumption with age was most obvious for sugar-sweetened soft drinks, fruit drinks, ice cream/ice confection and meat pies/savoury pastries. For example, the consumption of sugar-sweetened soft drinks increased from a mean of 222 g (about a cup) for 2–3 year olds to 714 g (nearly three cups) for 16–18 year olds, per-consumer. After age 12, male subjects, in general, consumed higher amounts of most 'extra' foods than female subjects, with males consuming significantly more pizza, margarine and fried potatoes in both the 12–15 year and 16–18 year groups, significantly more ice cream in the 12–15 year group, and significantly more sugar-sweetened soft-drink in the 16–18 year group. There were no 'extra' food items for which female subjects consumed significantly more than males.

'Extra' foods contributed 40.9% energy, 19.4% protein, 47.3% total fat, 47.0% saturated fat, 53.8% sugar, 25.9% dietary fibre, and approximately 20–25% of selected micronutrients, ranging from 15.3% for thiamine to 33.1% for retinol equivalents in the diets of 2–18 year olds (Table 4). Thus, 'extra' foods provided a high proportion of energy, fat and sugar relative to micronutrient content.

The proportion of energy contributed by 'extra' foods compared to core foods increased significantly with age (Table 4). 'Extra' foods contributed about one-third of energy intake for 2–3 year olds but increased to over 40% in older children. Similarly, the proportion of all nutrients contributed by 'extra' foods increased with age. In the youngest age group (2–3 years) the proportion of micronutrients derived from 'extra' foods was lowest (approximately 15–20%) compared to the older age groups (approximately 20–25%). There were no significant differences in the proportion of energy or nutrients derived from 'extra' foods between male and female subjects, with the exception of 16–18 year old male subjects who obtained a significantly higher proportion of energy (45.8 vs 39.0%), carbohydrate (49.1 vs 41.2%) and folate (28.4 vs 20.9%) from 'extra' foods compared to their female counterparts.

Total nutrient intakes from both core and 'extra' foods combined met 70% of the RDIs for all micronutrients for each age and sex subgroup. Intake of most micronutrients, particularly thiamine, niacin and vitamin C, met at least 70% of the RDI and were supplied in more than adequate amounts by core foods. However, the contribution of core foods to zinc intakes was lower than 70% of the RDI among

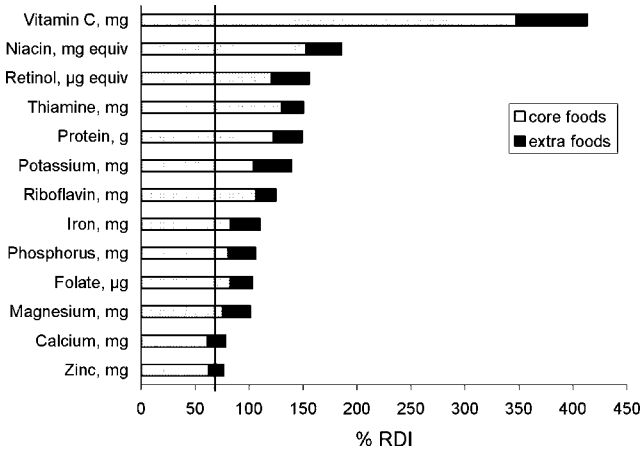

Figure 1 Nutrient contributions from core and 'extra' foods, expressed as percentage of RDI for 12–15 year old girls; 1995 NNS. Line indicates 70% RDI.

12–15 year old girls (63%) and 16–18 year old girls (69%), and the contribution of core foods to calcium intakes was lower than 70% of the RDI for 8–11 year old girls (69%) and 12–15 year old girls (62%). Figure 1 illustrates the nutrient contributions of core and 'extra' foods expressed as a percentage of RDI for 12–15 year old girls. Very little zinc and calcium were contained in the 'extra' foods consumed by these adolescent girls.

Discussion

This analysis of nationally representative survey data shows that the diets of Australian children and adolescents in 1995 included substantial amounts of 'extra' foods – those that are not core foods and should be limited in the diet as recommended in the AGHE. 'Extra' foods contributed an average of 41% to daily energy intake, which is two to four times higher than the recommended limit of 5–20%, as specified in the AGHE. The 'extra' foods contributing most to average energy intakes were fried potatoes (4.2%), sugar-sweetened soft drinks (3.3%), ice cream/ice confection (3.1%) and cordials (sugar-sweetened drink bases) (2.7%), with intakes of most of these, and of total 'extra' foods increasing with age.

Differences in dietary assessment methods, food coding and analysis procedures, and classification of foods as 'energy-dense, nutrient-poor', create difficulties in making valid comparisons with results among similar studies. Nevertheless, a recent analysis also based on the 1995 NNS database but using a slightly different classification system for 'extra' foods (using nutrition expert consensus compared to our standard food criteria), found the same percentage of energy contributed by 'extras' to that observed in our study (Bell *et al.*, 2005). Another recent Australian study of children aged 16–24 months, found that 'extra' foods

contributed an average of 27% of energy intake to the diet of toddlers (Webb *et al*., 2006). Although a 3-day weighed food record was used to assess dietary intakes and the classification criteria for 'extra' foods differed somewhat from the present study, their results are consistent with our findings that the percentage of energy contributed by 'extras' increases with age, that is, 33% for 2–3 year olds, 40% for 4–7 year olds and 43% for 8–18 year olds.

US studies based on two on-going NNSs have found somewhat lower proportions of energy contributed by energy-dense, nutrient-poor foods than our study of Australian children based on national survey data. A secondary analysis of data from the third National Health and Nutrition Examination Survey, 1988–1994, based on a 24-h recall dietary assessment showed that foods of high-energy density but low-nutrient density contributed just over 30% of daily energy to the diets of American children and adolescents aged 8–18 years (Kant, 2003). Data from the US Continuing Survey of Food Intakes by Individuals, 1989–1991 – CSFII, also based on the 24-h recall method, showed a similar result; approximately 30% of energy came from such foods in the diets of 2–18 year olds (Subar *et al*., 1998).

The lower proportion of energy from energy-dense, nutrient-poor foods in these US studies compared with our study may reflect, in part, the capacity of the US data analysis system to disaggregate mixed dishes into individual food components (Cleveland *et al*., 1997). For example, individual food components of a mixed dish such as pizza can be classified as bread, cheese, luncheon/processed meats and tomatoes. The high-fat luncheon/processed meats in this example may be the only ingredient classified as energy-dense, nutrient-poor, in the US survey analysis system. By contrast, in our study we allocated the entire weight of high-fat or high-sugar mixed dishes, such as pizza, to the 'extra' foods category, thus resulting in higher energy and nutrient intakes from these foods.

Munoz *et al*. (1997) reported a similar contribution to energy from energy-dense, nutrient-poor foods (over 40%) to that shown in our study, but this was calculated from all discretionary fat and sugar in the foods consumed by 2–18 year olds, as measured from 3-day weighed food records on a sub sample of the US CFII 1989–1991. Their criteria for identifying high-fat and high-sugar foods were more stringent than ours in that they classified the fat in full-cream milk and in non-lean meats as discretionary fats, along with all added fats to mixed dishes. In addition, mixed dishes were disaggregated into their food components.

These difficulties in interpreting the differences in survey results highlight the need for further development of coding, processing and classification schemes to better describe and compare food intakes and their contribution to diets, worldwide.

From our analysis, age and sex were important determinants of the types and amounts of 'extra' foods consumed by Australian children, and their contribution to energy intake. Younger children were more likely to consume cordials, fruit drinks, sweet and savoury biscuits, muesli and fruit bars, lollies and sweet spreads than older children. In contrast, older children and adolescents were more likely to consume sugar-sweetened soft drinks, meat pies and savoury pastries, sweet pastries, hamburgers and pizza than younger children. The quantities of total 'extra' foods consumed increased with age, as did many of the commonly consumed 'extra' food items. After age 12, significant sex differences in the consumption of 'extra' foods were observed, with males generally consuming larger quantities than females. This reflects, in part, the higher overall food intake of male subjects compared to female subjects.

The study by Subar *et al*. (1998) showed a similar trend in percentage energy from low-nutrient density foods increasing with age (25% for 2–5 years, 29% for 6–11 years, 32% for 12–18 years), whereas others found no differences in the various age and sex subgroups reported (Munoz *et al*., 1997; Kant, 2003).

The quantities of sugar-sweetened drinks consumed, including soft drinks, cordials and fruit drinks, were large. Among adolescents in the 16–18 year age group who consumed such drinks, the average consumption was nearly 3/4 of a litre per day. A high consumption of sugar-sweetened drinks has been linked to weight gain and obesity in children and adolescents (see reviews by Bachman *et al*., 2006; Malik *et al*., 2006) and interventions aimed at changing the quantities of such drinks has resulted in weight loss and the prevention of weight gain in adolescents (James *et al*., 2004; Ebbeling *et al*., 2006). Thus, these findings lend support for increasing action to reduce sweetened drink consumption by Australian children and adolescents (Gill *et al*., 2006).

Fried potatoes, hamburgers, pizza and meat pies were also commonly consumed and eaten in large amounts. The consumption of such foods has been associated with increased body weight and weight gain in children (Gillis and Bar-Or, 2003; Ebbeling *et al*., 2004; Taveras *et al*., 2005).

Nevertheless, most studies of dietary intake and weight status of children have not found associations between types and amounts of foods consumed (or energy intake), with weight status (Rodriguez and Moreno, 2006). Consumption of substantial amounts of energy-dense, nutrient-poor foods has been reported for children and adolescents regardless of weight status (Bandini *et al*., 1999; Kant 2003; Bell *et al*., 2005; Webb *et al*., 2006).

Relative to their energy, fat and sugar contributions to the diet, 'extra' foods provide only modest amounts of micronutrients. Also, there is some indication that 'extra' foods displace nutrient-dense, core foods in the diets of Australian children. The AGHE recommends that core foods provide 70% of the RDI for all nutrients, a recommendation that was not met for calcium and zinc among adolescent girls. As such, an increase in the consumption of core foods rich in calcium and zinc is needed among Australian children, particularly adolescent girls.

Our findings are consistent with another Australian study indicating displacement of core foods by 'extra' foods. Children aged 16–24 months in the highest quintile of 'extra' food intake had diets lower in most micronutrients than those in the lowest quintile (Webb *et al.*, 2006).

Similarly, the Kant study of US children showed that the greater the number of high energy-dense, nutrient-poor foods consumed, the lower the quantity of nutrient-dense foods consumed, in particular fruit and dairy products. Among higher consumers of energy-dense, nutrient-poor foods, most micronutrient intakes were lower, including vitamin A, B6, folate, calcium, magnesium, iron and zinc (Kant, 2003).

Several other studies have found that consumption of sugar-sweetened drinks is associated with a significant reduction in milk intake and consequently reduced intakes of protein, vitamin A, vitamin D, calcium and magnesium (Harnack *et al.*, 1999; Ballew *et al.*, 2000; Mrdjenovic and Levitsky, 2003; Frary *et al.*, 2004; Marshall *et al.*, 2005; Striegel-Moore *et al.*, 2006). Similarly, the consumption of fast foods, defined as those foods bought at fast food or pizza places, has also been linked to poor diet quality including higher intakes of energy, total fat, added sugars and sodium and decreased consumption of fibre, vitamins A and C, milk, fruit and non-starch vegetables (French *et al.*, 2001; Paeratakul *et al.*, 2003; Bowman *et al.*, 2004).

Micronutrients shown to be most 'at risk' of inadequate intake in children's diets include vitamins A, riboflavin, B6, calcium, iron, zinc and magnesium (Munoz *et al.*, 1997; Kant 2003; Magarey and Bannerman, 2003; Nessa and Gallagher, 2004; Webb *et al.*, 2006).

We may have under-estimated intakes of 'extra' foods in our study, owing to measurement error associated with the 24-h recall method of dietary assessment, particularly from difficulties in estimation of portion sizes, recalling precisely what was consumed, or deliberate misreporting. Under-reporting of energy intakes from incomplete or misreporting is associated with all dietary assessment methods although the extent and determinants of under-reporting among children are poorly understood (Livingstone *et al.*, 2004). In the survey database used in our study, 4–13% of males and females aged 10–15 years were classified as under-reporters – defined as persons whose ratio of energy intake to basal metabolic rate was <0.9 (Mackerras and Rutishauser, 2005).

Under-reporting would introduce bias if 'extra' foods such as cakes, cookies, sugar, soft drinks, confectionery and fats were selectively under-reported. Although this may well have occurred, owing to the widely held perception that such foods are 'unhealthy', there is no convincing evidence of this phenomenon in children (Sjoberg *et al.*, 2003; Lillegaard and Andersen, 2005). Nevertheless, if selective under-reporting has occurred, then our findings represent a conservative estimate of the consumption of energy-dense, nutrient-poor foods in the diets of Australian children.

Conclusion

In 1995, 'extra' foods contributed between two to four times the recommended limit for energy from such foods to the diets of Australian children aged 2–18 years. They also contributed large amounts of fat and sugar intakes, while providing relatively few micronutrients. The types of 'extra' foods contributing most to total energy intake include sugar-sweetened drinks, such as soft drinks, cordials and fruit drinks, fried potatoes and ice cream. Over-consumption of 'extra' foods may increase the likelihood of excess weight gain, and may reduce micronutrient intakes by possibly displacing the consumption of more nutrient-dense and less energy-dense, core foods. Intakes of calcium and zinc are particularly at risk. Thus, more effective efforts may be warranted to promote the message about limiting 'extra' foods. The results presented here will be useful for comparison with the results of future nutrition surveys, to document the changing patterns of 'extra' food consumption, and the diet quality of those with higher and lower intakes of 'extra' foods.

Acknowledgements

We thank Dr Jenny Peat for statistical advice.

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