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ORIGINAL COMMUNICATION

Lunchbox contents of Australian school children: room for improvement

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Objective: In light of the increasing prevalence of obesity in children and the potential of schools as a setting for intervention, we aimed to identify the main foods and beverages consumed at primary school and to determine differences in consumption patterns between children who used the school canteen and those who did not.
Design: Cross-sectional survey of school foods in 1681 5–12 y old children, 2003–2004.
Setting: Barwon South—Western region of Victoria, Australia.
Results: The school food provided an average (±s.e.m.) of 3087±26 kJ. Bread was the most frequently consumed food and contributed 20% of total energy at school, biscuits 13%, fruit 10%, muesli/fruit bars 8%, packaged snacks 7%, and fruit juice/cordial 6%. About 10% of children used the school canteen and these children obtained more total energy and more energy from cakes, fast foods and soft drink than noncanteen users ($P<0.001$). In all, 68% of children had fruit in their lunchboxes, however, over 90% of children had energy-dense, micronutrient-poor snacks ('junk food').
Conclusions: Fruit intake in primary schools seems reasonably high but could be targeted for further increase as part of promoting a healthy diet. Of concern, however, are the excessive amounts of energy-dense foods in school lunchboxes. These should be considered a priority for health promotion efforts along with reducing the consumption of sweetened drinks. These measures are urgently needed to improve the school-based diets of Australian children and attempt to curb the increasing prevalence of childhood obesity.
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Keywords: energy intake; school health; environment; child; Australia

Introduction

The International Obesity Task Force (IOTF) has reported that about 10% of the world's school-aged children are overweight or obese (Lobstein *et al*, 2004). In Australia, over 20% of children aged 7–15 y are either overweight or obese and alarmingly the prevalence of obesity in this age group doubled in the 10 years from 1985 to 1995 (Magarey *et al*, 2001). The increasing prevalence of overweight and obesity has important short and long-term health implications. Numerous studies have demonstrated increased occurrence of physical and metabolic abnormalities in obese children (Dietz, 1998; Lobstein *et al*, 2004; Weiss *et al*, 2004); however, the psychosocial consequences of childhood obesity are more widespread. Issues such as discrimination, stigmatisation, learning difficulties and persistence of the condition into adulthood are significant concerns facing obese children (Must & Strauss, 1999; Lobstein *et al*, 2004).

The school environment is recognised as an important setting where changes can be made to curb the increasing prevalence of overweight and obesity in children (Centers for Disease Control and Prevention, 1997; Weschler *et al*, 2000; Carter & Swinburn, 2004; Lobstein *et al*, 2004). Students spend approximately 32 h per week at school and this setting has been demonstrated to have a powerful influence on students' eating behaviours (Kubik *et al*, 2003). By promoting healthy eating and increased physical activity, schools can play an important part in reducing the 'obesogenic' environment children are increasingly exposed to. However, it is important to develop strategies within the school environment that are relevant and practical. To this

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end, information is needed regarding food consumption patterns and physical activity of children while they are at school.

In Australia, recent estimates suggest that on a school day, approximately one-third of the total energy intake of 5–15 y-old children is consumed at school (Bell & Swinburn, 2004). Further, in Australian schools, the majority of food is brought from home, with only 14% of children purchasing food from the school canteen (Bell & Swinburn, 2004). Despite this knowledge, there is little recent information available on the food and beverage consumption patterns of Australian children while they are at school. The most recently published analysis utilised data collected as part of the 1995 National Nutrition Survey (NNS) and, while these data may not reflect current consumption patterns, it suggested a high intake of energy dense foods.

The aims of this study were: (1) to determine the main foods and beverages consumed at school and their contribution to energy intake, (2) to examine canteen use and foods purchased within the school environment, (3) to compare the cost of school lunches across socio-economic groups, and (4) to compare current dietary patterns with those collected from the 1995 NNS.

Methods

Survey design and participants

Participants were recruited from a regionally representative sample of 18 primary schools in the Barwon South–Western region of Victoria. These were baseline measurements in schools involved in a community-based intervention project broadly aimed at improving the health and well being of children aged 2–12 y and preventing the development of childhood obesity. The Barwon South–Western region is made up of eight networks. All six primary schools in one network were used and a probability proportional to size (PPS) sampling method was used to draw a representative sample of children from primary schools across the other seven networks. Written consent was obtained from parents or guardians of all participants and ethics approval was given by the Deakin University Human Research Ethics Committee.

Anthropometry

Weight, height, and waist circumference were measured in accordance with standard methods for the collection of anthropometric data in children (Davies *et al*, 2001) by a trained researcher. All measures were taken in light clothing and without shoes. Weight was measured to the nearest 0.05 kg using electronic scales (A&D Personal Precision Scale UC-321), height was measured to the nearest 0.1 cm using a portable stadiometer (PE87 portable stadiometer), and waist circumference measured to the nearest 0.1 cm using a plastic tape measure. Two measurements were recorded for each parameter and where there was disagreement between these measures a third measure was recorded. Where a third measure was recorded, the mean of the two closest measures was used for further analysis. Body mass index (BMI; weight (kg)/height(m^2)) was calculated and the IOTF BMI cutoffs were used to classify children's weight status as either healthy, overweight, or obese (Cole *et al*, 2000).

School food checklist

The School food checklist (SFC) constitutes a single-page checklist designed to record food availability according to over 20 food and beverage categories that were coded according to the number of servings present (or actual weight), specific descriptors of the food (eg reduced fat, white/brown, diet), and food source (home, canteen, or vending machine). The foods and beverages were categorised into practical groupings according to energy density in the context of the typical Australian school lunch (see Figure 2 for details of each category). A copy of the SFC can be viewed on-line (Sentinel Site for Obesity Prevention, 2004). Research staff received extensive training on how to complete the SFC. A food model booklet was provided to assist research staff to determine serve size and electronic scales were also available to weigh foods where actual serve size could not be estimated. Food in the lunchbox was recorded as early as possible after the children arrived at school, before any break times in most cases. The foods were unpacked by the child and the contents recorded by a trained interviewer. Where there were uncertainties about the foods, children were asked for more information. Children were also asked about any orders from the canteen or intended purchases from the canteen during break times. Children then repacked their lunchboxes and could consume its contents throughout the day. The SFC has been calibrated for use against a one day weighed food record in 106 children with the two methods showing a mean difference of 15 kJ and a Pearson correlation coefficient of 0.77 (unpublished data).

The 'junk food' category comprised the food groupings detailed in Table 2 that were deemed to mainly contain foods that were energy dense but of low micronutrient value (ie biscuits, cakes, muesli/fruit bars, packaged snacks, and chocolates/lollies). The amount of 'junk food' present was categorised as follows: one serving: up to and including one serving, two servings: >1 and up to and including two servings, three servings: >2 and up to and including three servings, four servings: >3 and up to and including four servings, etc.

Comparison with data from the 1995 NNS

In 1995–1996, the Australian Bureau of Statistics conducted a National Health Survey (NHS) in all States and Territories across urban and rural areas of Australia. Households were selected at random using a stratified multistage area sample. The NNS was a subcomponent of the NHS, conducted several weeks later with a sample of approximately 13 800 persons

aged 2 y and over. The NNS used face-to-face 24-h recall interview to measure food and beverage intake and parents/care givers were interviewed on behalf of children aged up to 14 y. In the NNS there were 1656 children aged 5–15 y who had weekday dietary data available (Bell & Swinburn, 2004). We were able to analyse data from the NNS that had been categorised into 22 food groups according to previously published methodology (Bell & Swinburn, 2004). Only food and drink consumed between 0900 and 1500 hours on weekdays were included for analysis. For the current study the dietary data were re-examined by restricting the participants age to 5–12 y ($n=1249$) and then generating descriptive data on the food groups. The food groupings are directly comparable to those in the SFC detailed above.

Statistical analysis

Children were divided into two age groups: younger (aged 5–9 y) and older (aged >9–12 y). Socioeconomic status (SES) was assessed using The Socio-Economic Index for Areas (SEIFA), specifically the index of relative socio-economic advantage/disadvantage was used for analysis. This index is based on data collected from the 2001 Australian census of population and housing and incorporates variables such as income, education, occupation, living conditions, access to services, and wealth. The SEIFA classification used was based on geographic postal area of the child's address and a higher score on the index indicates that an area has a relatively high proportion of people with high incomes or a skilled workforce, and also a low proportion of people with low incomes and relatively few unskilled people in the workforce (Australian Bureau of Statistics, 2001).

Discriminant function analysis (DFA) was used to compare the contribution of each food group to overall energy intake by generating functions able to discriminate between gender, age groups, SEIFA quartiles, and canteen *vs* noncanteen users, adjusted for age, gender, and SES as appropriate. DFA is a technique used to predict group membership using a set of predictors (Tabachnick & Fidell, 1989). DFA was used to predict canteen users from nonusers on the basis of food group choices. Children were grouped as 'canteen users' if they purchased (or intended to purchase) any item from the school canteen during that school day. Analysis of variance (ANOVA) was used to assess differences in number of servings of 'junk food' by SES. Statistical significance was accepted at $P\leq 0.05$. All analyses were conducted using SPSS version 11.5 (SPSS Inc.). All results are mean $\pm$ s.e.m. unless otherwise stated.

Results

Table 1 shows the anthropometric and socio-demographic characteristics of the 1681 children (mean age: 8.7 ± 0.05 years) in this study. When divided into quartiles of SES, it was apparent that there was an overrepresentation of children from the lowest quartile and an under-representation of children from the highest quartile in our study group. This means that in our study population there were more children from areas of low SES and fewer from areas of high SES than expected when compared to the averages for the State of Victoria.

Table 1 Socio-demographic and anthropometric characteristics of 1681 children aged 5–12 y

Socio-demographic characteristics	
Age 5–9 y, *n* (%)	941 (56.0)
Age >9–12 y, *n* (%)	740 (44.0)
Female, *n* (%)	853 (50.7)
SES[a] quartile 1($\leq$25%), *n* (%)	696 (42.4)
SES[a] quartile 2(25–50%), *n* (%)	453 (27.6)
SES[a] quartile 3(50–75%), *n* (%)	426 (25.9)
SES[a] quartile 4(>75%), *n* (%)	68 (4.1)
Anthropometric characteristics	
Weight (kg) (s.d.[b])	32.4 (10.1)
Height(cm) (s.d.)	132.2 (12.3)
Waist circumference (cm) (s.d.)	64.2 (9.1)
BMI[c] (kg/m^2) (s.d.)	18.1 (3.0)
Overweight[d], *n* (%)	455 (27.1)

[a]Socioeconomic status (SES) based on SEIFA: Index of relative socio-economic advantage/disadvantage from 2001 Australian census, High quartile = high socio-economic status.
[b]s.d.: standard deviation.
[c]BMI: Body mass index.
[d]Using the criteria of Cole *et al* (2000).

Table 2 shows the energy intake and food sources for all children in the study. The most frequently consumed foods were bread, fruit, fat spreads, biscuits, muesli/fruit bars, and packaged snacks. Food categories that were recorded at a frequency less than 2% have been omitted from the table. A typical school lunch consisted of about one sandwich, two biscuits, a piece of fruit, a snack of either a muesli/fruit bar or some other packaged snack, and a drink of fruit juice/cordial or water.

Boys consumed significantly more total energy at school than girls (3154.1 ± 37.7 kJ *vs* 3021.5 ± 36.2 kJ, $P=0.02$), while girls consumed more energy from fruit ($10.9\pm0.4\%$ *vs* $9.0\pm0.3\%$, $P<0.001$) and yoghurt than boys ($0.8\pm0.13\%$ *vs* $1.3\pm0.18\%$, $P=0.03$), adjusted for age and SES.

Younger children (aged 5–9 y) consumed significantly more total energy and a higher proportion of energy from cakes/buns, sweet spreads, and desserts than older children (aged >9–12 y), after adjusting for gender and SES. Younger children also had significantly less proportional energy from bread, fruit, and meat/seafood/egg fillings than older children (Table 3).

There were a number of differences in the energy contribution of certain food groups by quartiles of SES. Overall, children classified as being in the lowest SES quartile (ie the most disadvantaged) had significantly more energy from fruit juice/cordial, packaged snacks, chocolates/lollies, fat spreads, and soft drinks but significantly less energy from cakes/buns, fast foods, and fruit than all other children, adjusted for age and gender (Table 4).

Table 2 Energy intake and food sources at school for Australian children aged 5–12 y

Food group	*Frequency (%)*	*Servings (mean (s.e.m.))*	*Energy and contribution to energy (%)*		
			All (n = 1681)	*Non-canteen users (n = 1517)*	*Canteen users (n = 164)*
Energy (kJ) (s.e.m.)			3087 (26)	3052 (27)[a]	3411 (86)
Foods					
Bread (including rolls and flat bread)	80.1	0.9 (0.1)	19.9	21.8[a]	2.9
Biscuits (sweet, savoury, and crackers)	57.2	1.7 (0.05)	13.3	13.9[a]	7.7
Cakes (including buns, slices, muffins, and donuts)	24.8	0.2 (0.01)	7.4	7.0[a]	11.0
Fruit (fresh, canned, and snack tubs)	67.7	0.8 (0.02)	10.0	10.3[b]	7.3
Muesli/fruit bars (fruit, muesli, and snack bars)	41.8	0.5 (0.02)	8.3	8.7[a]	5.0
Packaged snacks (including corn and potato chips (crisps), pretzels, popcorn)	35.9	0.4 (0.01)	6.7	6.8	5.7
Sweet spreads (honey, jam, chocolate spreads, and icing)	19.4	0.2 (0.01)	2.2	2.4[a]	0.5
Fat spreads (butter, margarine, and peanut butter)	68.1	0.9 (0.02)	7.0	7.6[a]	0.8
Meat/seafood/egg filling (including ham, processed meat, meat, tuna, salmon, and boiled egg)	27.9	0.3 (0.01)	1.9	3.6[a]	0.3
Vegetables (including salad, salad filling, carrot, or celery sticks)	12.6	0.2 (0.01)	0.2	0.2	0.04
Fast food (including pies, pasties, hot dogs, hot chips, and pizza)	10.6	0.1 (0.01)	4.5	0.8[a]	39.1
Chocolates/lollies (including lollies, sweets, candies, and chocolates)	27	0.3 (0.02)	4.0	4.0	4.2
Cheese, dried fruit, and nuts	30	0.4 (0.02)	4.1	4.3[a]	1.3
Desserts (ice creams, ice confectionary, and dairy desserts)	5.2	0.06 (0.01)	0.8	0.5	0.8
Yoghurt (full- and reduced-fat)	6.5	0.04 (0.01)	1.1	1.1[c]	0.3
Beverages					
Fruit Juice/cordial (fruit juice, fruit drink, and cordial)	32.4	0.6 (0.02)	6.3	6.4	5.7
Soft drinks (diet and regular)	2.1	0.02 (0.00)	0.5	0.1[a]	3.7
Milk (full- and reduced-fat)	2.5	0.03 (0.00)	0.6	0.3[a]	3.5
Water (bottled and tap)	33.8	0.7 (0.03)			

[a]$P<0.0001$.
[b]$P=0.001$.
[c]$P=0.02$ compared to canteen users, adjusted for age, gender and SEIFA index, discriminant function analysis.

Table 3 Food categories that are significantly different between age groups (adjusted for gender and SES)

	Age 5–9 y	*Age >9–12 y*
Energy (kJ)	3145 (34.5)	3013 (39.9)[a]
Cakes/buns	8.2 (0.49)	6.4 (0.49)[b]
Sweet spreads	2.5 (0.17)	1.8 (0.16)[b]
Desserts	1.02 (0.15)	0.66 (0.13)[c]
Bread	19.4 (0.4)	20.7 (0.5)[c]
Fruit	9.5 (0.3)	10.6 (0.4)[c]
Meat/seafood/egg fillings	1.7 (0.1)	2.2 (0.1)[b]

Data are percent contribution to energy (s.e.m.).
[a]$P<0.03$.
[b]$P\leq 0.02$.
[c]$P<0.05$, discriminant function analysis.

Table 4 Food categories that are significantly different between children of lowest SES and the rest (adjusted for age and gender)

	Lowest SES[a]	*Others*
Fruit juice/cordial	7.6 (0.4)	5.3 (0.3)[b]
Packaged snacks	7.9 (0.4)	5.8 (0.3)[b]
Fat spreads	7.4 (0.3)	6.7 (0.2)[c]
Chocolates/lollies	5.2 (0.4)	3.3 (0.2)[b]
Soft drinks	0.8 (0.2)	0.3 (0.1)[d]
Fruit	8.9 (0.4)	10.8 (0.3)[b]
Fast foods	3.6 (0.5)	5.1 (0.5)[c]

Data are percent contribution to energy (s.e.m.).
[a]Lowest SES (socio-economic status), SEIFA index quartile 1.
[b]$P\leq 0.0001$.
[c]$P\leq 0.05$.
[d]$P=0.006$, discriminant function analysis.

We undertook a basic cost analysis of the main foods in the children's lunches and found that on average, lunches of children in the lowest SES quartile were more expensive than lunches of children in the highest SES quartile (data not shown). The price differential was $AUD0.26, and although this is small it is a statistically significant difference ($P=0.002$) and represents close to 20% of the estimated total lunch cost.

Almost all children had some 'junk food' in their lunchboxes (as defined in the Methods) with a mean of 3.1 ± 0.06 servings. Figure 1 shows that only 7% of children

had no servings of 'junk food', 15% had up to one serving, and over half (51%) had 2–4 servings. The presence of 'junk food' in the lunchbox was significantly associated with SES, with those children who did not have 'junk food' present having a higher mean SEIFA index score (more advantaged) than those who did have 'junk food' present (951.7 ± 4.0 *vs* 939.9 ± 1.1, $P = 0.004$), adjusted for gender and age. Overall, there was a tendency for children of lower SES to have more servings of 'junk food' ($P = 0.05$) and when categorised into quartiles of SES, children from households below the 25th percentile had a mean of 3.2 servings of 'junk food', those between the 25th and 50th percentile for SES had a mean of 3.4 servings of 'junk food', those between the 50th and 75th percentile for SES had a mean of 3.0 servings of 'junk food' and those above the 75th percentile for SES had a mean of 2.8 servings of 'junk food'.

We were also interested in examining the foods and beverages purchased within the school environment, as well as those brought from home. In the present study, 9.8% of children purchased food from the school canteen or food service. Canteen users had significantly more total energy and energy from cakes, fast food, milk and soft drinks and significantly less energy from bread, biscuits, fruit, muesli/fruit snack bars, sweet spreads, fat spreads, cheese/eggs/nuts, and yoghurt compared to noncanteen users, adjusted for age, gender, and SES (see Table 2).

Beverage consumption was also of interest and the most frequently consumed beverages were water and fruit juice. On average children consumed 0.6 servings of fruit juice/cordial (contributing an average of 6% of total energy at school). There were no differences in beverage consumption between gender or age groups.

Figure 2 shows a comparison of food group contribution to energy consumed at school between the 1995 NNS and the present data. The main sources of energy at school in 1995 were bread (22%), fast foods (10%), fruit drinks (8%), fat spreads (6%), and biscuits (6%). Despite different methodologies for data collection, comparisons with the current findings show some interesting differences. Children at school appeared to be now consuming less energy from bread (−2.0 percentage points (pp)), milk (−3.6 pp), and fast food (−5.5 pp) than they were in 1995, but more energy from biscuits (+7.1 pp), fruit/muesli bars (+5.3 pp), cakes (+2.2 pp), fruit (+4.9 pp), and packaged snacks (+1.6 pp) compared to 1995.

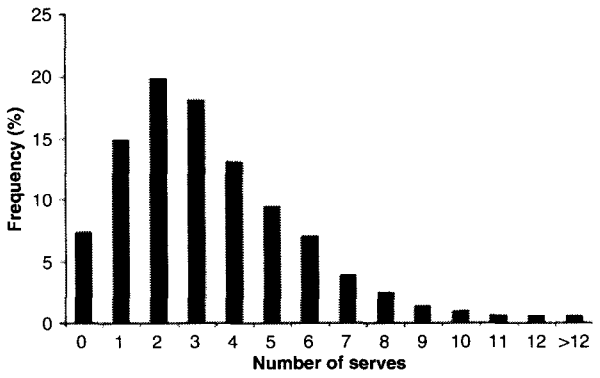

Figure 1 Servings of 'junk food' present in school lunchboxes.

Discussion

This study assessed the food consumed in school by primary school children in the Barwon-SW region of Victoria and found a reasonably high proportion of fruit in lunch boxes

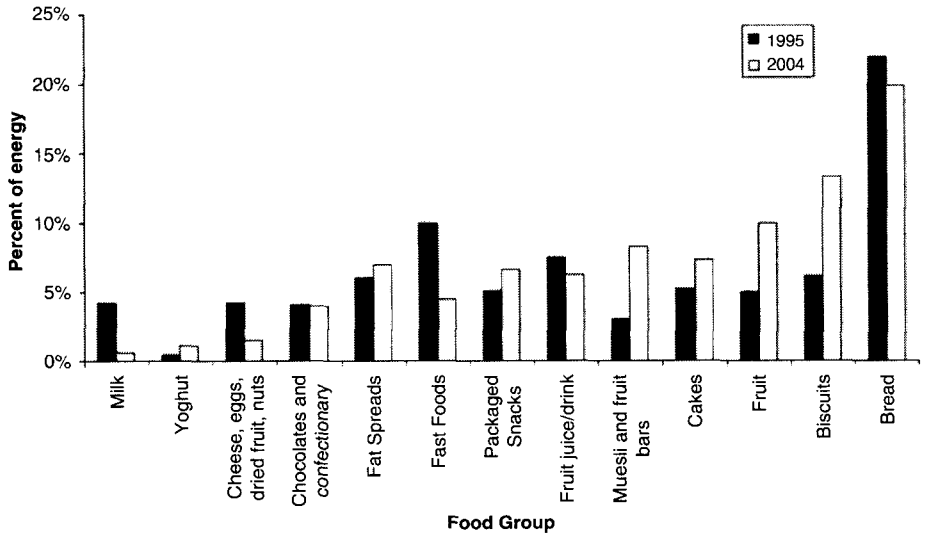

Figure 2 Comparison of food group contribution to 'at school' energy intake between 1995 and 2004 for children aged 5–12 y.

(a bit less than one serve on average) and a high proportion of energy-dense snack foods or 'junk food' (just over three servings on average). About one-third of children also had a fruit juice/cordial drink. Socio-economic disadvantage was associated with more energy-dense snacks and fruit juice/cordial drinks.

Overall our results depict a typical school lunch that is broadly characteristic of Australian primary school children in that most food is brought from home and contains a sandwich, a piece of fruit, several snacks and a drink; a structure that does not appear to have changed substantially over time (Bell & Swinburn, 2004). Higher energy intakes were seen in boys and canteen users and interestingly, younger children also consumed more energy at school than older children. This latter finding may reflect the higher proportion of energy derived from cakes, sweet spreads (in sandwiches), and desserts by younger children, and possibly describes a dietary profile indicative of either a cohort effect (a trend over time towards less healthy lunches) or parents providing more 'treats' to younger children. Our analysis found no significant differences in weight status between children who used the canteen and those who did not. However, we do not feel that this should be taken as evidence for the safety of an unhealthy diet as our study assessed only a proportion of the child's daily food intake, and further this was only on one occasion. In addition, despite the lack of association between increased prevalence of overweight/obesity and canteen use, we feel the foods offered for sale at the school canteen should be those associated with maintaining a healthy weight and also reinforcing universal healthy eating messages.

Our data also appear to confirm the importance of SES on dietary quality. A recent study of German children identified that overweight families of low SES have the highest risk of overweight and obese children (Danielzik *et al*, 2004). This is true in most Western societies and dietary differences are thought to play an important role (Lobstein *et al*, 2004). In our study, children from areas of low SES consumed more sweetened drinks and energy dense foods, and less fruit than other children. Interestingly, a cost analysis of a typical lunch showed that lunches of children in the lowest SES group cost approximately 20% more than the lunches of children in the highest SES group. When the cost difference was multiplied out for the 40-week school year, parents in the lowest SES group appeared to be spending just over $52 AUD more per child. While the amount may seem small the result suggests that changes can be made to the diets of children of low SES that will provide more nutritious food and remain affordable.

It is widely accepted that consumption of sweetened beverages plays a role in the development of obesity in children (Swinburn *et al*, 2004) and at least one study has shown a dose-dependent increase in BMI and prevalence of obesity in children with each additional serve of sweetened beverage (Ludwig *et al*, 2001). Approximately one-third of children in the present study drank fruit juice/cordial at school, while water was found in only one-third of children's lunchboxes. These findings suggest that consumption of sweetened beverages needs to be reduced in this age group and water should be promoted as the drink of choice for children, particularly while at school.

In order to gain some insight into current trends in school food consumption, we determined school-based dietary intakes of selected food groups for children aged 5–12 y who participated in the 1995 NNSNNS in Australia. Similar food group data from the NNS have been published previously for children aged 5–15 y (Bell & Swinburn, 2004). One potential limitation to this comparison is that the NNS was conducted over a longer time frame and therefore may have included school holiday periods. Also, the NNS was across the whole of Australia whereas our study is confined to the Barwon South-Western region of Victoria and therefore some socio-demographic differences, such as SES and ethnicity, will exist between the two populations. Further, a 24 h dietary recall was used to assess food and beverage consumption in the NNS while we used our own instrument, the SFC. Despite these caveats we feel some broad comparisons can be made, particularly as there is a dearth of appropriate data for comparison. We were looking for trends only, and the food groupings used for the comparison were directly comparable with the Barwon South–Western data.

Examining the mean proportion of energy derived from select food groups between 1995 and 2004 highlights a number of interesting differences, including potential changes in snack choice. Where previously children may have been taking snacks from the cheese, eggs, nuts, and dried fruit category there now seems to be a noteworthy increase in fruit as a snack, but also an important shift towards packaged snacks, muesli/fruit bars, cakes, and biscuits to fill the lunch box. This trend towards more energy-dense, micronutrient-poor snacks needs to be addressed, particularly in light of the fact that children do not appear to bring just one item from this range of food, but often multiple snacks of these types.

In conclusion, the present study paints a disturbing picture of the dietary patterns of Australian children while at school. The foods and beverages consumed are commonly of low nutritional value and are often high in sugar, fat and salt. In particular, this appears to be an issue for children of low SES, younger children and those who use the school canteen or food service. The canteen is an important icon in Australian schools and the food offered for sale goes a long way to indicate the underlying priority for healthy eating and nutrition at the school. Significant improvements need to be made to canteen menus in order to decrease the amount of energy-dense, micronutrient-poor food purchased by students and increase the dietary quality of those who use the food service. However, the majority of food consumed in Australian schools is brought from home and parents need to be encouraged to remove energy dense snacks from their children's lunch boxes and replace them

with fruit and other nutritious alternatives. In addition, consumption of water at school needs to increase, with a subsequent decrease in intake of sweetened beverages.

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