What are the key food groups to target for preventing obesity and improving nutrition in schools?

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Objective: To determine differences in the contribution of foods and beverages to energy consumed in and out of school, and to compare consumption patterns between school canteen users and noncanteen users.


Setting: Australia.

Subjects on school days: A total of 1656 children aged 5–15 y who had weekday 24-h dietary recall data.

Results: An average of 37% of total energy intake was consumed at school. Energy-dense foods and beverages such as fat spreads, packaged snacks, biscuits and fruit/cordial drinks made a greater contribution to energy intake at school compared to out of school (P ≤ 0.01). Fast foods and soft drinks contributed 11 and 3% of total energy intake; however, these food groups were mostly consumed out of school. Fruit intake was low and consumption was greater in school. In all, 14% of children purchased food from the canteen and they obtained more energy from fast food, packaged snacks, desserts, milk and confectionery (P ≤ 0.05) than noncanteen users.

Conclusions: Energy-dense foods and beverages are over-represented in the Australian school environment. To help prevent obesity and improve nutrition in schools, biscuits, snack bars and fruit/cordial drinks brought from home and fast food, packaged snacks, and confectionery sold at canteens should be replaced with fruit and water.

Keywords: energy intake; school health; environment; Australia

Introduction

In Australia, over 20% of children aged 7–15 y are either overweight or obese, and obesity prevalence doubled in the 10 y from 1985 to 1995 (Margarey et al, 2001). Obesogenic schools may be contributing to this epidemic (Egger & Swinburn, 1997). An obesogenic school promotes positive energy balance. This occurs when the average energy intake of students from food and beverages consumed in the school setting is high and the energy expended in school through playground activity, physical education classes and incidental activity is low. It has been estimated that children in the US get 20–40% of their total physical activity at school and for many, physical education classes may be the only source of moderate or vigorous activity (Simons-Morton et al, 1990). Other US estimates suggest that somewhere between one quarter and a third of total school day energy is provided by school lunches (Radzikowski & Gale, 1984; Farris et al, 1992). Unlike the US where a National School Lunch Program provides lunch to approximately 59% of all public-school children, most children in Australia bring their lunch from home. At a majority of schools, children may also purchase food and drink from an on-campus canteen. There are over 7000 canteens in Australian schools run by school officials, parents and/or students. They differ considerably in their management systems, operating hours, price and the range of products offered for sale. The Lysterfield Primary School canteen is one example (http://www.lysterps.vic.edu.au/canteen.html). We do not know what proportion of daily energy intake children obtain at school or how canteen foods differ from lunchbox foods.
One way to measure the obesogenicity of a school with respect to energy intake is to identify the key food groups contributing to the energy intake of children at school compared to out of school. The contribution of canteen foods to energy intake can also be measured in this way. Insight into the consumption patterns of energy-dense foods in school is valuable because it allows public health and education professionals to develop interventions that are specific to the school setting (Dietz & Gortmaker, 2001). Also, conscious control over the consumption of energy-dense foods is needed if individuals are to maintain a healthy body weight (Westerterp-Plantenga, 2001). The aims of this study were to: (1) determine differences in the contribution of foods and beverages to energy consumed in and out of school and; (2) to compare consumption patterns between school canteen users and non-canteen users.

Methods
Survey design and participants
In 1995–1996, the Australian Bureau of Statistics conducted a National Health Survey in all States and Territories across urban and rural areas. Households were selected at random using a stratified multistage area sample. The National Nutrition Survey (NNS95) was a subcomponent of the NHS conducted several weeks later and, while drawn from a varied population, was not nationally representative. The sample was systematically selected from the base NHS sample of private dwellings and approximately 13,800 persons aged 2 y and over participated. Details of the survey have been published elsewhere (McLennan & Podger, 1995). In Australia, children can begin school at age 5 y and the minimum legal school leaving age is 15 y. For this reason, we focused on children surveyed in NNS95 who were aged 5–15 y, a total of 1980. Of these, 324 had their dietary data collected on weekends and they were excluded from the analysis because our primary interest was in total energy intake at school.

Dietary data collection
The survey used a face-to-face 24-h recall interview to measure food and beverage intake. The method was adapted from that used in the Continuing Survey of Food Intake by Individuals (CSFII) 1994–1996 from the United States (USDA) and involved three phases: the completion of a quick list of food eaten or drunk during the previous 24-h; collection of detailed information for each food and drink item listed in the quick list and; a recall-review to allow respondents to report any foods that may have been forgotten. Parents or caregivers were interviewed on behalf of children aged 0–14 y, while those aged 15 y and older reported their own intakes. Information was also collected on day of the week, the time of day each food was eaten, the source of the food and whether it was consumed at home. We created a binary variable separating foods consumed on Monday to Friday between the hours of 09:00 and 15:00 (school hours for the majority of children aged 5–15 y) from those consumed outside of these hours to distinguish energy consumed at school from energy consumed outside of school. Within the school setting, we then made a distinction between those who obtained some or all of their energy intake from the school canteen and those who obtained all of their energy from their lunchbox. As children are required to remain on campus, the vast majority of food and drink consumed at school will be from either the canteen or the lunchbox.

Foods contributing to energy intake were separated into 22 categories that were both typical of Australian school lunches and relatively homogeneous with respect to the energy density (eg when we ranked all the four-digit NNS95 foodcodes by energy density, those summarized into the fat spreads category ranked from 1 through 16 with a median of 8). The categories are listed in Table 2 along with a summary of the foods they contain. A complete list of the foods in each category is available from the authors.

Statistical analysis
Our primary interest was in comparing differences in food category sources of energy in and out of school during the school week. This required a within-person comparison of energy intake. Obviously, most children would have eaten both at school and in a variety of other places. We used a paired t-test assuming equal variance to test the hypothesis that the contribution of a particular food group to energy intake at school would equal the contribution of the same food group to energy intake out of school.

To compare the food-group energy intakes of canteen vs non-canteen users, we used multivariable regression. These comparisons were adjusted for gender, age and level of social disadvantage.

Finally, we were also interested in sociodemographic differences in the proportion of total energy intake obtained at school. We divided age into two categories, 5–11 y and 12–15 y to reflect the approximate ages of children at primary and middle school. Social disadvantage was measured using quintiles of the SEIFA (socioeconomic indexes for areas) index. The index was derived from the 1991 census and it assigns an index to geographic areas based on socioeconomic variables such as economic resources of households, education, occupation, family structure and ethnicity (McLenan & Podger). Multivariable regression was used to determine significant differences in the proportion of total energy obtained at school across age, gender and SEIFA index. Similarly, we used logistic regression to test for sociodemographic differences in those who purchased food from the canteen compared to those who did not. Statistical significance was accepted at P ≤ 0.05. All analyses were conducted in Stata version 7.0.

Results
Table 1 provides a summary of the sociodemographic and anthropometric characteristics of the children in this study.
including total energy intake. The prevalence of overweight varied with age and gender. Children aged 5–11 y were less likely to be overweight (19%) than those aged 12–15 y (33%) (OR 0.49, 95% CI 0.39–0.62 adjusted for gender and seifa index) and boys (17%) were less likely to be overweight than girls (30%) (OR 0.54, 95% CI 0.37–0.59). There were no socioeconomic differences in overweight prevalence.

Based on the 24-h recall, these children had an average school day energy intake of 7056 kJ/day (Table 1). In total, 37%, or 2602 kJ/d, of this energy was consumed at school. This sounds high, however, if weekend and holiday energy intakes are also considered over a school year, food and beverages consumed at school contribute to 16% of total energy intake. School sources of energy made a greater contribution to the energy intake of girls compared to boys. Girls obtained 39.5% of their energy at school, while boys obtained 35.7% (P ≤ 0.01, adjusted for age, and seifa index). Younger children (38.6%) also obtained more of their energy intake at school than older children (35.5%) (P ≤ 0.01, adjusted for gender and seifa index). The proportion of energy consumed at school did not vary consistently with seifa index.

Interesting differences were observed when we compared the contribution of various food groups to energy intake in and out of school (Table 2). The top five food groups contributing to energy intake at school were bread, fast foods, fruit/cordial drinks, fat spreads and biscuits and crackers. Collectively these five food groups accounted for more than 50% of energy intake at school. The top five food groups contributing to energy intake out of school were mixed dishes, leftovers or staples, fast foods, milk, bread, and meat and desserts were fifth equal. These food groups contributed over 50% of energy out of school. Bread, fat spreads, cheese, eggs, nuts and dried fruit, packaged snacks,
biscuits and snack bars made significantly larger \((P \leq 0.01)\) contributions to energy at school compared to energy out of school. Mixed dishes and staples, meats, seafood, desserts, milk and vegetables were significantly greater contributors to energy out of school where breakfast and dinner are the main meals. However, it should be noted that vegetable intake was low in both the contexts. Vegetables contributed \(\sim 61\text{ kJ/person/day} to mean energy intake, equivalent to the energy in half a carrot (\(\sim 109\text{ kJ in a 61.0 g carrot}\) or 1/5 of a cup of peas (\(\sim 174\text{ kJ in 0.5 of a cup of cooked peas}\)). Fruit made a significantly greater contribution to energy at school (5.0%) compared to energy out of school (2.8%, \(P \leq 0.01)\) although, once again overall intake was low (\(\sim 250\text{ kJ/person/day} or the equivalent of one small apple (106 g)). Chocolate and confectionary made a significantly greater contribution to energy intake at school, whereas fast foods made a greater contribution to energy out of school. Fast foods contributed at least 10% of energy in both the contexts. For beverages, fruit/cordial drinks were the most commonly consumed in the school setting, contributing to 7.9% of energy. Soft drinks were not a major contributor to energy in or out of school, while milk made a greater contribution to out of school energy.

Another way of looking at the data is to consider energy intake at school as a proportion of total intake from a particular food group. Figure 1 highlights an interesting pattern. Approximately 57% of energy from packaged snacks was consumed at school. Other food groups where more than 50% of energy came from school include snack bars (74%), bread (59% and also fat spread, 54%, not shown) and fruit (51%). Just under 50% of energy from fruit cordial drink was consumed at school. On the other hand, sweet spreads (66%), fast food (67%), soft drinks (67%) and vegetables (87%) were predominantly consumed out of school.

Canteen users consumed \(\sim 200\text{ kJ/more energy at school than those who obtained energy only from their lunchbox (}P = 0.053\)). Marked differences were observed in the contribution of various food groups to the energy intakes of canteen vs noncanteen users (Table 3). Compared to nonusers, canteen users obtained significantly more energy from fast food, packaged snacks, desserts, chocolate and confectionary and milk (\(P \leq 0.05\)). Nonusers obtained significantly more energy from bread, fat spreads, biscuits and crackers, sweet spreads, fruit/cordial drinks, fruit and other sources.

There were few sociodemographic differences in the contribution food groups to energy intake at school. We did find that packaged snacks made less of a contribution to the energy intake of children in the middle of the Seifa index compared to those at the top (4.1% in quintile 3 vs 6.2% in quintile 5, \(P = 0.014)\). Within the school environment there were no significant sociodemographic differences in canteen use. Boys (14.4%) were slightly more likely to obtain energy from the canteen compared to girls (13.2%) as were 5-11-y-old children (14.5%) compared to 12-15-y-old children (12.4%). No consistent pattern was observed with Seifa index although those in the highest quintile (15.8%) were slightly more likely to obtain energy from canteen.

### Table 3

<table>
<thead>
<tr>
<th>Food group</th>
<th>Noncanteen users</th>
<th>Canteen users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kJ (s.e.))</td>
<td>2571 (37)</td>
<td>2769 (95)</td>
</tr>
<tr>
<td>Fat spreads (%)</td>
<td>6.6a</td>
<td>3.9</td>
</tr>
<tr>
<td>Packaged snacks (%)</td>
<td>4.4a</td>
<td>8.5</td>
</tr>
<tr>
<td>Biscuits (%)</td>
<td>6.5a</td>
<td>3.9</td>
</tr>
<tr>
<td>Chocolate and confectionary (%)</td>
<td>3.7b</td>
<td>5.3</td>
</tr>
<tr>
<td>Snack bars (%)</td>
<td>2.9</td>
<td>2.5</td>
</tr>
<tr>
<td>Sweet spreads (%)</td>
<td>1.7a</td>
<td>0.8</td>
</tr>
<tr>
<td>Cheese, eggs, nuts and dried fruit (%)</td>
<td>4.5</td>
<td>3.7</td>
</tr>
<tr>
<td>Cakes and buns (%)</td>
<td>5.5</td>
<td>6.7</td>
</tr>
<tr>
<td>Muffins and scones (%)</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Fast foods (%)</td>
<td>8.2a</td>
<td>21.2</td>
</tr>
<tr>
<td>Bread (%)</td>
<td>22.6a</td>
<td>15.6</td>
</tr>
<tr>
<td>Meat (%)</td>
<td>3.3</td>
<td>2.6</td>
</tr>
<tr>
<td>Seafood (%)</td>
<td>0.6</td>
<td>0.2</td>
</tr>
<tr>
<td>Leftovers, mixed dishes and staples (%)</td>
<td>3.0b</td>
<td>1.2</td>
</tr>
<tr>
<td>Desserts (%)</td>
<td>2.6a</td>
<td>4.4</td>
</tr>
<tr>
<td>Yoghurt (%)</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Fruit (%)</td>
<td>5.2b</td>
<td>3.6</td>
</tr>
<tr>
<td>Vegetables (%)</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Other (%)</td>
<td>2.4a</td>
<td>0.7</td>
</tr>
<tr>
<td>Beverages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruit/cordial drink (%)</td>
<td>8.1a</td>
<td>5.6</td>
</tr>
<tr>
<td>Softdrink (%)</td>
<td>3.0</td>
<td>2.1</td>
</tr>
<tr>
<td>Milk (%)</td>
<td>3.7a</td>
<td>5.9</td>
</tr>
</tbody>
</table>

\(a,b)\) Significantly different proportion of energy from those who ate at the canteen adjusted for gender, age, and Seifa index at \(P \leq 0.01\) and \(P < 0.05\), respectively, multivariable regression.
foods than those in the lowest (11.1%, OR 1.50, 95% CI 0.94-2.32 adjusted for gender and age).

Discussion
In a country where obesity is the major health issue confronting children, it is disturbing that energy-dense foods are most commonly consumed at school. Clearly, the driving forces behind this are not related to health but rather to non-nutritive issues such as taste, convenience and food safety (Shannon et al, 2002). Preferences for sweet, energy-dense foods are well developed by the time children attend school (Drewnowski, 2000), and, if available, children will always eat fatty, sugary snack foods in preference to more nutritious options. Add this preference to that of parents for convenient foods that can be easily carried to school and it is not too surprising that energy-dense packaged foods, such as those at the top of Table 2, are overwhelming school lunchboxes. On top of this, as parents become increasingly time pressured, they may seek to satisfy their child’s, or their own, emotional needs by rewarding children with ‘treat’ foods at school. Food safety regulations may also be part of the problem. Australia has a plethora of food safety regulations designed to protect children from food poisoning. A downside of these regulations may be that they limit consumption of fresh or homemade foods and encourage consumption of packaged foods. Food manufacturers are well attuned to all these factors and provide a vast array of packaged foods (eg snack bars) and beverages (eg juice boxes) designed specifically for school lunches that are heavily marketed as tasty, convenient and safe.

The driving forces behind school canteen sales are also non-nutritive. School canteens exist primarily for profit and packaged snacks, chocolate, confectionary and fast foods are considered to be the most profitable items. Once again, many parents see the canteen as an opportunity to ‘treat’ or reward their children and therefore do not see the need for canteens to sell healthy choices. A recent study of dietary fat sources in US middle schools found that school-based sources (ie school cafeteria and a la carte items) provided more fat than food brought from home (bag lunches) (Zive et al, 2002). In our study, total energy intakes were not significantly different between canteen users and nonusers and the lunchbox foods were not necessarily more healthful. However, there were marked differences in the numbers of children who brought food from home (86 vs 31%) and school canteens in Australia and the US are very different.

Based on the high consumption of energy-dense foods, the Australian school environment appears to be more obesogenic than nonschool environments and improvements are warranted in both lunchboxes and school canteens. From our study, the obvious lunchbox intervention is to replace energy-dense food groups like biscuits, crackers and snack bars with fruit. Fruit intake is low both in and out of school (Magarey et al, 2001), but schools are the best environment for promoting fruit because children consume most of their fruit in this context. The amount of fat spread could also be reduced and vegetables in sandwiches increased. School canteens should cut down on sales of packaged snacks, chocolate and confectionary and fastfoods and increase sales of fruit. One way to do this and ensure continuing profits would be to cross subsidise the healthier choices by placing higher margins on less healthy choices. Western Australia and New South Wales both run canteen accreditation programs that help schools run healthy, profitable canteens. For beverages, fruit/cordial drinks should be replaced with water. Lugwig et al (2001) consider soft drinks to be an independent risk factor for obesity, and studies have shown that liquid carbohydrate promotes positive energy balance (DiMeglio & Mattes, 2000).

In the US, soft drinks contribute over 5% of total energy intake among 2-18 year olds (1994-1996) (Nielsen et al, 2002). In this study, soft drinks contributed less (~3%) and they were mostly consumed out of school. More of a problem were fruit/cordial drinks that contributed to almost 8% of total energy intake at school, much higher than that reported in the US (3.1% for 2-18 year olds). These drinks offer few nutritional benefits over soft drinks, they are just as energy-dense and they have implications for dental health. Water is a healthier and more convenient alternative. Surprisingly, the school canteen was not the major source of fruit/cordial or soft drinks, but was the major source of milk beverages. There is some evidence that soft drink consumption replaces milk consumption and, in light of the low calcium intakes of many children, we would encourage sales of low-energy milk from canteens (Harnack et al, 1999; Neumark-Sztainer, 2002). Interventions such as those recommended here should not only reduce the energy and fat intakes of Australian children, but also improve their micronutrient intakes. The CATCH school-based intervention study found that over a 2 and 1/2 year period decreases in fat intake were associated with increases in the nutrient density of most vitamins and minerals, the exceptions being sodium and vitamin E (Nicklas et al, 1996; Ogusian et al, 1996).

Our study has several limitations. The cross-sectional design limits us to describing these associations at a particular point in time. Since the data were collected in 1995, current consumption patterns may differ from those observed here. We did not have a direct method for differentiating school food from nonschool food and it is possible that foods consumed on the way to or from school were included as school foods. Finally, the results are limited to the comparison of group means because single 24-h recalls are subject to large intrindividual variability.

High consumption of energy-dense foods and beverages in schools is concerning in light of the obesity epidemic among Australian children. In spite of the commonly held belief that food from school canteens is less healthy than food brought from home, the nutritional value of foods from both sources needs improvement. Ideally, parents should include more fruit in their children’s lunchboxes and reduce the
number of biscuits, snack bars and juice/cordial drinks. Fruit should also be promoted in the school canteen in place of fast food, packaged snacks and confectionary. Water and low-energy milk are the best drinks for children at school.

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References