

Association of key foods and beverages with obesity in Australian schoolchildren

Andrea M Sanigorski*, A Colin Bell and Boyd A Swinburn

School of Exercise and Nutrition Sciences,
Deakin University, 1 Gheringhap Street, Geelong, Victoria 3220, Australia

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Abstract

Objective: To examine the pattern of intake of key foods and beverages of children aged 4–12 years and the association with weight status.

Design and setting: A computer-assisted telephone interview was used to determine the intake of fruit, vegetables, packaged snacks, fast foods and sweetened drinks 'yesterday' and 'usually' as reported by parents/guardians of a representative sample of 2184 children from the Barwon South-Western region of Victoria, Australia.

Results: Children who consumed >2–3, >3–4 and >4 servings of fruit juice/drinks 'yesterday' were, respectively, 1.7 (95% confidence interval (CI) 1.2–2.2), 1.7 (95% CI 1.2–2.5) and 2.1 (95% CI 1.5–2.9) times more likely to be overweight/obese compared with those who had no servings of fruit juice/drink 'yesterday', adjusted for age, gender and socio-economic status (SES). Further, children who had ≥ 3 servings of soft drink 'yesterday' were 2.2 (95% CI 1.3–3.9) times more likely to be overweight/obese compared with those who had no servings of soft drink 'yesterday', adjusted for age, gender and SES. In addition, children who 'usually' drank fruit juice/drinks twice or more per day were 1.7 (95% CI 1.2–2.4) times more likely to be overweight/obese compared with those who drank these beverages once or less per week, adjusted for age, gender and SES. Although fast foods and packaged snacks were regularly eaten, there were no associations between weight status and consumption of these foods.

Conclusions: Intake of sweetened beverages was associated with overweight and obesity in this population of Australian schoolchildren and should be a target for intervention programmes aimed at preventing unhealthy weight gain in children.

Keywords
Obesity
Children
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Nutrition
Australia

Excessive weight gain in children, as in adults, is ultimately the result of a long-term energy imbalance. A high intake of energy-dense foods and energy-containing beverages such as fruit drinks and soft drinks is likely to promote unhealthy weight gain. Several studies have shown that the consumption of snacks and low-quality foods is positively associated with overweight in children^{1,2}, although the positive relationship between dietary fat intake and body weight remains to be definitively established^{3,4}. Intake of fast food by children has increased by 300% in two decades², and the amount of fast food eaten may serve as an indicator of an overall unhealthy eating pattern. Bowman *et al.* have shown that on days when children consumed fast food products, the energy levels of their diet were higher, the energy density per gram was higher and the fruit and vegetable consumption was lower, resulting in a diet less likely to be healthful compared with days on which fast food products were not consumed⁵.

Consumption of sweetened beverages has also been associated with overweight in children in a number of studies^{1,6–9}. Ludwig *et al.*⁷ found that in children aged

11–12 years, the odds of becoming overweight increased 60% for each serving of sweetened drink consumed daily. In addition, a randomised control trial by James *et al.* showed that decreasing the intake of carbonated beverages in children aged 7–11 years resulted in a reduction in the prevalence of overweight⁶.

As a general strategy for obesity prevention, the World Health Organization recommends a lower consumption of foods that are high in fat, sugar and starch, and drinks that are high in free sugars, and a higher consumption of foods that are relatively energy-dilute such as fruits and vegetables¹⁰. These changes are likely to reduce total energy intake and also improve micronutrient intake in the population. In Australia, fruit and vegetable intakes of children aged 2–18 years in 1995 were well below those recommended by government agencies, with <20% of all children achieving an adequate intake of both fruits and vegetables¹¹. In addition, a recent study has identified sweetened beverages such as soft drinks and cordials as prominent sources of refined sugar in the diets of Australian children aged 2–18 years¹².

*Corresponding author: Email andrea.sanigorski@deakin.edu.au

Since the last National Nutrition Survey in 1995, there have been few population-based assessments of childhood eating patterns in Australia. The aim of the current study, therefore, was to examine the pattern of intake of fast foods, packaged snacks, fruit, vegetables and sweetened beverages by Australian children aged 4–12 years and the association with weight status.

Methods

Survey design and participants

Participants were recruited from a regionally representative sample of eight kindergartens and 18 primary schools in the Barwon South-Western region of Victoria. These were baseline measurements in settings involved as either intervention or comparison schools in a community-based intervention project. Written consent was obtained from parents or guardians of all participants, and ethics approval was given by the Deakin University Human Research Ethics Committee. All children at the schools were eligible to participate, and of those 2184 (50%) enrolled in the study. Complete data sets were obtained for 1944 subjects, and data from these subjects are presented.

Computer-assisted telephone interview (CATI)

The instrument used for the CATI of parents/guardians consisted of questions designed to capture, among other things, information regarding children's usual (recorded as the number of times per week a food was consumed, see Table 3) and recent (recorded as the number of servings consumed yesterday (Monday–Friday) as in Table 2) intake of fruit (one serving = a medium apple, orange, banana or pear, or two small pieces of fruit or a bunch of grapes, or a cup of diced fruit pieces), vegetables and legumes (one serving = one cup of salad vegetables, or half a cup of cooked vegetables, beans or peas, not including potatoes or fries), packaged snacks (such as potato crisps, corn chips, cheezels, etc. one serving = half a standard (50 g) bag of crisps, or one small snack pack), and 'take-away' or fast food (such as fish and chips, pies, pasties, hamburgers, fried chicken, pizza and Chinese; one serving = a pie/pastie, a bucket of hot chips, a plain hamburger, one hot dog, etc.). We were also interested in intake of soft drink (non-diet carbonated beverages) (one serving = 250 ml) and fruit juice/drink (100% fruit juice, diluted fruit juices (fruit drink) and cordials (including energy-containing flavoured mineral water and sports drinks one serving = 250 ml tetra pack or a standard glass)).

Details of parents' sociodemographics were also collected. Interviews were conducted for each child in the family by trained interviewers at a time deemed suitable by the parent or guardian. The CATI was administered by asking each question and presenting parents/guardians with the range of possible responses,

including 'don't know' or 'not applicable' options. Each interview took ~20 min. Where there was more than one child per household, parents/guardians were given the option of completing subsequent surveys at a later date.

Anthropometry

Weight, height and waist circumference were measured in accordance with standard methods for the collection of anthropometric data in children¹³ 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 Milpitas, CA, USA), height was measured to the nearest 0.1 cm using a portable stadiometer (PE87 portable stadiometer; Carnegie), and waist circumference measured to the nearest 0.1 cm using a plastic tape measure. Two measurements were recorded for each variable and, where there was disagreement, a third measure was recorded and the average of the two closest used for analysis. Body mass index (BMI) was calculated and the International Obesity Task Force BMI cut-offs were used to classify children's weight status as either healthy or overweight (including obese)¹⁴.

Statistical analysis

The Socio-Economic Index for Areas (SEIFA) used was the index of relative socio-economic advantage/disadvantage. The 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, 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 workforce¹⁵.

Logistic regression was used to compare intake patterns between children classified as healthy weight and those classified as overweight (including obese) adjusted for age, gender and SEIFA. The outcome variable was weight status, and comparisons were made between the referent group (those who consumed no serves of the food/drink 'yesterday', and those whose usual frequency of consumption was once or less a week, for analysis of consumption 'yesterday' and 'usually', respectively) and those who consumed more.

Statistical significance was accepted at $P \leq 0.05$. All analyses were conducted using SPSS version 12.0.1 (SPSS Inc.).

Results

Table 1 describes the sociodemographic and anthropometric characteristics of the 2184 children in this study. When divided into SEIFA quartiles, it was apparent that

there was an over-representation of children from the lowest quartile and an under-representation of children from the highest quartile in our study group, compared with the State of Victoria, Australia.

Table 2 shows that on the day before the survey ('yesterday'), the majority of children consumed fruit and vegetables. Of concern, however, was the finding that 11% of children ate no fruit and 21% ate no vegetables, and overall 5% of all children (6.2% of boys and 3.8% of girls) had neither fruit nor vegetables on the day before the survey (data not shown). In addition, on the day before the survey, 47% of the children ate packaged snacks and 74% had at least one glass of fruit juice/drink, with 23% having >3 servings. Only a relatively small proportion of children were reported to have fast foods (17%) and soft drinks (23.9%) 'yesterday'.

Overall, children who had fruit and vegetables the previous day were more likely to be overweight/obese compared with children who had no fruit or vegetables; however, this was only statistically significant for children who were in the highest intake category. Children who had more than two servings of fruit juice/drinks or more than three servings of soft drink the previous day were also significantly more likely to be overweight/obese compared with children who did not. Intake of fast foods and packaged snacks on the day before the survey was not associated with weight status.

Table 3 shows the usual frequency of consumption of these key foods and beverages. The majority of children had fruit at least once per day (78.3%), and vegetables >5 times per week (80.1%). Sixty-five per cent of children had packaged snacks more than once per week; however, the majority of children (86.8%) had fast food/take-aways once a week or less. There were no significant associations between weight status and usual consumption of fruit, vegetables, packaged snacks or fast food. When looking at usual beverage consumption, a large proportion of children drank fruit juice/drink once per day or more

(64.5%), and children who drank fruit juice/drinks twice or more per day were more likely to be overweight/obese compared with those who drank these fruit juice/drinks once or less per week. The majority of children did not usually consume soft drinks more than once a week (68.9%), and while the prevalence of overweight and obesity was higher for those who drank soft drinks more than once per week, there was no significant association with weight status.

Discussion

Australian dietary guidelines recommend that children consume at least five servings of vegetables per day and two servings of fruit. Packaged snacks and fast foods, however, are considered occasional or 'sometimes' foods. While 62% of children had two or more servings of fruit on the day prior to the survey, we found that only 12% of children had more than three servings of vegetables on the day. Moreover, while most children had fast food once a week or less, over one-third of the children had packaged snacks very regularly (five or more times a week). The Australian dietary guidelines are ambiguous with respect to sweetened drinks and need to be clarified, as we found that fruit juice/drinks in particular were consumed frequently and in large amounts. Children who regularly had fruit juice/drinks, and those who had large amounts of fruit juice/drink the day before the survey were about twice as likely to be overweight or obese as the reference group.

Beverages can make a significant contribution to the energy content of the diet, and there is evidence to show that higher intakes of liquid carbohydrates may lead to weight gain because of a lack of dietary compensation compared with that seen with intake of comparable amounts of solid carbohydrate¹⁶. Drinking sweetened beverages has been previously linked with overweight in children and adolescents from the USA and the UK^{1,6-9}, and our findings confirm this association in Australian children. In addition, although fruit juice/drinks rather than soft drinks are the sweetened drink of choice for young Australian children^{17,18}, our study found an association with weight status and both types of drink. We found that children who drank more than two glasses (500 ml) of fruit juice/drink 'yesterday' were more likely to be overweight or obese, with the odds increasing as the amount of fruit juice/drink consumed increased. In addition, the children who drank more than three glasses of soft drink (>750 ml) 'yesterday' were more than twice as likely to be overweight or obese, compared with children who did not drink soft drinks. This research highlights the need for prospective studies that assess the impact of replacing sweetened drinks in the diets of children with drinks that do not contain energy, and also confirms that sweetened drinks represent a potential target

Table 1 Characteristics of the study population

Sociodemographic characteristics	
Age, years (SD)	8.3 (2.2)
Female, <i>n</i> (%)	1137 (52.1)
SEIFA quartile 1 ($\leq 25\%$), <i>n</i> (%)	890 (41.9)
SEIFA quartile 2 (25–50%), <i>n</i> (%)	573 (27.0)
SEIFA quartile 3 (50–75%), <i>n</i> (%)	486 (22.9)
SEIFA quartile 4 (>75%), <i>n</i> (%)	177 (8.3)
Total, <i>n</i> (%)	2184 (100)
Anthropometric characteristics	
Weight, kg (SD)	31.1 (10.4)
Height, cm (SD)	129.8 (14.0)
Waist circumference, cm (SD)	63.4 (9.0)
BMI, kg m ⁻² (SD)	18.0 (2.9)
Overweight*, <i>n</i> (%)	581 (26.7)

SD – standard deviation; SEIFA – Socio-Economic Index for Areas (index of relative socio-economic advantage/disadvantage from the 2001 Australian census, high quartile = high socio-economic status); BMI – body mass index.

* Overweight, including obese, as defined by Cole *et al.*¹⁴.

Table 2 Servings of key foods and drinks eaten 'yesterday' by Australian children aged 4–12 years and odds of being overweight/obese ($n = 1944$)

	Consumption yesterday (servings)	Frequency (%)	Proportion overweight/obese (%)	Adjusted OR (95% CI)
Fruit*	0	11.3	21.2	Referent
	1	26.3	27.7	1.4 (1.0–2.1)
	2	32.7	25.7	1.3 (0.9–1.9)
	3	18.8	27.9	1.5 (1.0–2.2)
	>3	10.9	29.4	1.7 (1.1–2.6)
Vegetables†	0	21.2	22.4	Referent
	1	25.0	28.5	1.4 (1.0–1.9)
	2	22.0	26.5	1.3 (0.9–1.8)
	3	20.1	26.7	1.3 (0.9–1.8)
	>3	11.7	30.0	1.5 (1.0–2.2)
Packaged snacks‡	0	52.9	27.4	Referent
	1	36.6	25.4	0.9 (0.7–1.1)
	2	7.4	26.6	0.9 (0.6–1.4)
	≥3	3.1	26.2	0.9 (0.5–1.7)
Fast foods§	0	82.9	26.9	Referent
	1	14.8	23.4	0.8 (0.6–1.1)
	>1	2.3	35.6	1.5 (0.8–2.9)
Fruit juice/drinks¶	0	26.0	21.2	Referent
	1–2	29.1	22.8	1.1 (0.8–1.5)
	>2–3	21.5	30.7	1.7 (1.2–2.2)
	>3–4	11.6	31.4	1.7 (1.2–2.5)
	>4	11.8	35.2	2.1 (1.5–2.9)
Soft drinks	0	76.1	25.5	Referent
	1	15.6	28.5	1.1 (0.9–1.5)
	2	5.6	26.2	1.0 (0.6–1.6)
	>3	2.7	43.1	2.2 (1.3–3.9)

OR – odds ratio; CI – confidence interval.

*Fruit: 1 serving = 1 medium apple, orange, banana or pear, or two small pieces of fruit or a bunch of grapes, or a cup of diced fruit pieces.

†Vegetables and legumes: 1 serving = 1 cup of salad vegetables, or half a cup of cooked vegetables, beans or peas, not including potatoes or fries.

‡Packaged snacks: 1 serving = half a standard (50 g) bag of crisps, corn chips, cheezels, etc., or one small snack pack.

§Fast food or take-away: 1 serving = 1 pie/pastie, 1 bucket of hot chips, 1 plain hamburger, 1 hot dog, 1 piece fried fish or fried chicken or pizza.

¶Fruit juice/drink: 1 serving = 250 ml tetra pack or a standard glass of 100% fruit juice, diluted fruit juices (fruit drink) or cordials (including energy containing flavoured mineral water and sports drinks).

||Soft drink (non-diet carbonated beverages): 1 serving = 250 ml.

for interventions aimed at reducing obesity prevalence in children.

Although not associated with weight status, the dietary data show that overall, children are also consuming large amounts of packaged snacks regularly. These snacks often contain high amounts of fat, salt and sugar, and their consumption may displace other, more nutritious food from the diet. Sixty-five per cent of children were reported as having packaged snacks at least once per week, and close to 20% of children usually had these snacks once a day or more. Previous research has found that the majority (close to 60%) of energy consumed from packaged snacks by Australian children occurs while they are at school¹⁷. These snacks are conveniently designed to fit into lunch boxes and easily carried to school and consumed by children. However, parents need to recognise the high energy and low nutrient value of these packaged snacks and should be encouraged to include more healthful alternatives. One such alternative could be as simple as a piece of fruit. Our data show that close to 90% of all children consumed fruit on the day before the survey, and usual consumption patterns suggest that close to 80% of

children consume fruit daily. While these results are encouraging, on the day before the survey ~10% of children had no fruit, and usual consumption patterns indicate that ~20% of children do not regularly consume fruit daily. These findings are similar to those of Magarey *et al.* whose analysis of the 1995 Australian National Nutrition Survey (NNS95) found that 20% of young children did not consume fruit (including juice) on the day of the survey¹¹. Encouraging fruit as a snack for children would be beneficial for a variety of reasons, but mainly because of the nutrient-rich, energy-dilute nature of fruit compared with the high-energy, nutrient-poor packaged snacks currently consumed by children in large amounts.

Results from our analysis indicate that ~20% of children had no vegetables the day before the survey and ~20% did not consume vegetables regularly. Data from the NNS95 suggest that for children aged 5–15 years, close to 90% of daily vegetable intake occurs out of school¹⁷, thereby placing a heavy reliance on the evening meal to provide the recommended number of servings of vegetables to achieve an adequate intake. Strategies that help parents overcome some of the barriers they face in

Table 3 'Usual' frequency of consumption of key foods and drinks by Australian children aged 4–12 and odds of being overweight/obese years ($n = 1944$)*

	Usual frequency of consumption	Frequency (%)	Proportion overweight/obese (%)	Adjusted OR (95% CI)
Fruit	≤ Once week ⁻¹	5.4	23.1	Referent
	2–4 times week ⁻¹	9.7	21.4	0.9 (0.5–1.6)
	5–6 times week ⁻¹	6.6	28.3	1.3 (0.7–2.5)
	Once day ⁻¹	46.5	28.2	1.3 (0.8–2.2)
	≥ Twice day ⁻¹	31.8	25.9	1.2 (0.7–2.0)
Vegetables	≤ Once week ⁻¹	3.7	21.1	Referent
	2–4 times week ⁻¹	16.2	24.9	1.2 (0.7–2.3)
	5–6 times week ⁻¹	31.4	27.0	1.4 (0.8–2.5)
	Once day ⁻¹	43.9	27.0	1.1 (0.8–2.5)
	≥ Twice day ⁻¹	4.8	27.7	1.4 (0.7–3.0)
Packaged snacks	≤ Once week ⁻¹	35.4	27.3	Referent
	2–4 times week ⁻¹	32.9	25.2	0.9 (0.7–1.2)
	5–6 times week ⁻¹	13.0	24.6	0.9 (0.6–1.2)
	Once day ⁻¹	16.0	28.9	1.1 (0.8–1.4)
	≥ Twice day ⁻¹	2.7	28.3	1.0 (0.6–2.0)
Fast foods	≤ Once week ⁻¹	86.7	26.4	Referent
	> Once week ⁻¹	13.3	27.8	1.1 (0.8–1.4)
Fruit juice/drinks	≤ Once week ⁻¹	15.8	20.9	Referent
	2–4 times week ⁻¹	15.0	25.6	1.3 (0.9–1.9)
	5–6 times week ⁻¹	4.7	24.4	1.2 (0.7–2.1)
	Once day ⁻¹	35.1	25.7	1.3 (0.9–1.8)
	≥ Twice day ⁻¹	29.4	31.3	1.7 (1.2–2.4)
Soft drinks	≤ Once week ⁻¹	68.9	25.5	Referent
	2–4 times week ⁻¹	20.7	28.1	1.1 (0.9–1.5)
	5–6 times week ⁻¹	1.7	36.4	1.7 (0.8–3.5)
	Once day ⁻¹	7.0	28.1	1.1 (0.8–1.7)
	≥ Twice day ⁻¹	1.8	29.4	1.1 (0.5–2.4)

OR – odds ratio; CI – confidence interval.

* See footnotes to Table 2 for food/drink serving information.

encouraging their children to eat more vegetables, such as neophobia or unfamiliarity, may go some way to increasing vegetable intake by children¹⁹.

Surprisingly, we found that children who consumed the highest amounts of fruit and vegetables the day before the survey were more likely to be overweight or obese compared with children who did not eat fruit or vegetables on this day. This finding may be the result of several factors: a higher volume of food being eaten by overweight/obese children, positive changes in the diets of overweight/obese children towards more healthful choices made by parents concerned about their children's health, or parental bias when reporting on the food intake of overweight/obese children, in particular²⁰.

In the current study, we examined recent and usual intake of key food groups and examined associations with weight status. There was a significant association between weight status and sweetened beverages, primarily fruit juice/drinks; however, no associations were found between intake of fast foods and packaged snacks, and weight status, after adjusting for age, gender and SES. There may be several reasons for this lack of relationship, including the following study limitations. In our study, parents were interviewed and reported on the consumption patterns of their children and, although this proxy method of data collection does not rely on children's memory for accuracy, it may be associated with bias due to

lack of parental knowledge of children's eating habits (particularly food eaten away from home), inability to estimate exact serving sizes and the possibility of a differential recall bias by parents across children's weight status categories²⁰. Despite the lack of relationship between high-energy, low-nutrient foods and weight status in our study, we feel this is not evidence for a lack of impact on promoting overweight, because a population diet which is poor will promote unhealthy weight gain in all, but particularly in those predisposed for other reasons (e.g. genetics or environmental).

In conclusion, our survey of Australian children from the Barwon South-Western region of Victoria with relatively low SES reveals a disturbing picture of high intakes of packaged snacks and sweetened drinks. Our study found that while many children are consuming reasonable quantities of fruit and vegetables, there is still room for improvement. We also found a positive association between sweetened drinks and overweight in this study, building the case for research that assesses the impact of reducing children's consumption of these beverages.

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