

Nutrients and foods consumed by New Zealand children on schooldays and non-schooldays

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Abstract

Objective: To describe and compare food and nutrient intakes in New Zealand (NZ) children on schooldays and non-schooldays.

Design: Secondary analysis of cross-sectional data from the NZ 2002 Children's Nutrition Survey. Dietary intake was assessed using computer-assisted multi-pass 24 h dietary recalls in the home. Data were adjusted for survey weightings to be representative of the NZ population. The effect of day category on nutrient intake, and likelihood of consumption of food categories were determined using linear and logistic regression.

Setting: NZ homes and schools.

Subjects: A total of 2572 children (538 non-schooldays and 2034 schooldays) at the age of 5–14 years.

Results: There were differences in the proportion consuming some food groups between schooldays and non-schooldays, although the majority of nutrient intakes including energy did not differ by day category. Mean cholesterol intake was higher on non-schooldays; dietary fibre and available carbohydrate, in particular sucrose and fructose, were higher on schooldays. Hot chips were twice as likely to be consumed on a non-schoolday. Soft drink consumption was higher on non-schooldays for Māori/New Zealand European and others and powdered drinks/cordial consumption did not vary by day category. More children consumed snack bars (normal weight, obese), fruit, sandwiches, biscuits/crackers and snack foods on schooldays. There was no difference in consumption of pies/sausage rolls by day category.

Conclusions: The proportion of consumers of a variety of foods differed significantly between non-schooldays and schooldays; few nutrient intakes differed. The present study indicates that family food, wherever it is consumed, is the mainstay of nutrition for NZ schoolchildren.

Keywords
Children
School
Food intakes
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Nutrients

Efforts to improve the diets of children have largely focused on the school environment^(1,2). Reports of foods popularly sold in schools have bolstered concerns about the impact of the school environment on children's nutrition overall⁽³⁾. School environments may be influenced by government policy with regard to both what may be sold on the premises and curriculum content. However, children only attend school on about one-half of the days of the year (190–200 d for New Zealand (NZ) children)⁽⁴⁾. In addition, only approximately one-third of children's nutrient and energy intakes are consumed during school hours⁽⁵⁾. Meals are not provided by NZ schools, although food items are usually available for purchase at tuck shops/canteens, a situation similar to Australia and Denmark. This means that it is particularly important to consider the role of the non-school environment, lunches sourced from home, on overall intake.

The times and patterns of children's eating on schooldays and non-schooldays (day category) differ, and therefore it might be expected that nutrient intakes also differ between day categories. However, there are very few published data describing and comparing intakes by day category, and where data are available they are from countries in which school meals are provided^(6–8). Texan children (9–12 years) consumed less energy and a slightly higher energy from fat on weekends⁽⁶⁾. US children (6–11 years; 1994–1996 Continuing Survey of Food Intakes by Individuals) had no difference for energy intake, energy from fat or carbohydrate, but a lower intake of protein as a percentage of energy (%E), on Fridays and weekends⁽⁷⁾. A small survey of Scottish children (5–17 years) found no difference in the intake of energy, fat, saturated fat (%E) or non-milk extrinsic sugars between term time *v.* holidays, or weekends *v.* weekdays⁽⁸⁾. However, data

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about foods consumed and intake of other nutrients have not been addressed in any of these studies.

Although nutrient intakes of NZ children are reported as satisfactory for most nutrients⁽⁹⁾ (nutrients of concern include calcium, iron and vitamin A⁽⁹⁾), there is a need to explore whether day category has any association with intake of these nutrients. There is a high prevalence of overweight (21%) and obesity (10%) in NZ children⁽⁹⁾ and dietary efforts to address this issue have focused on making 'healthy' food choices in the school environment⁽¹⁰⁾ but have not addressed the equally important non-school environment.

The present study of a nationally representative sample of children compares nutrient and food intake on schooldays *v.* non-schooldays, with ethnic comparisons.

Methods

The present study is a secondary analysis of the NZ 2002 Children's Nutrition Survey, a cross-sectional survey of a national sample of children (5–14 years), during the 2002 school year.

A school-based sampling frame was used, with an oversampling of Māori and Pacific children to allow for ethnic-specific analyses. Of the 190 schools sampled, 172 (91%) participated in the study. Recruitment from each school was in proportion to the number of students on the school roll. Children were assigned to one of three ethnic categories: Māori, Pacific or New Zealand European and others (NZEO), with a different probability of selection by ethnicity, based on their distribution from the 2001 school rolls. Of the 4728 children invited to participate, 3275 (69%) participated in the study.

Socio-economic status was assigned using the New Zealand Index of Deprivation (NZDep01), derived from the child's residential address, and based on eight dimensions, including income, access to a car and living space⁽¹¹⁾. Details of the survey methodology are described elsewhere⁽⁹⁾. All thirteen NZ regional health ethics committees gave approval for the survey.

Trained interviewers collected dietary intake data using a computer-assisted three-pass 24 h dietary recall in children's homes. Children recalled all food/drinks consumed in the 24 h before the interview. Nutrient intakes were calculated (NZ Food Composition database⁽¹²⁾). Foods consumed were coded to food groups for calculation of prevalence of consumption (Appendix).

Non-schooldays included weekends, national public holidays and school holidays⁽⁴⁾. Children recalled intake during the 24 h before the interview; thus, recalls that included both schooldays and non-schooldays (*n* 703) were not included in these analyses. The remaining recalls were categorized by day category, as schooldays only or non-schooldays only.

Height and weight were taken at each child's school using portable standardized equipment. BMI was calculated

and the reference cut-off values of Cole *et al.*⁽¹³⁾ were used to categorize children as normal, overweight or obese. BMI category was available for 2393 (93%) children with recalls included in the present analysis.

Statistical analyses were carried out using the STATA statistical software package version 10.01SE (StataCorp, College Station, TX, USA). Survey commands used sampling weights and primary sampling units (schools) ensuring that the results were representative of the NZ population. Variables whose distributions were not normal were transformed to logarithms. Multiple linear regression was used to examine the relationship between day category and nutrient intake. Because age, sex, ethnicity, NZDep01 and obesity have been associated with food choices and/or nutrient intake, these variables were included in the model. Age was considered a categorical variable (5–6, 7–10 and 11–14 years) and NZDep01 status as quintiles. We estimated the adjusted mean nutrient intake for day categories based on these models. Logistic regression was used for estimating the prevalence (95% CI) of consumers of food groups by day category, and interactions between day category, sex, age, ethnicity and BMI category were tested using the standard statistical techniques embedded in STATA. A *P* value of <0.05 was considered statistically significant.

Results

There were 2034 children whose 24 h dietary recall period covered schooldays; 538 children recalled non-schooldays (Table 1).

Nutrient intake

Energy and micronutrient intake did not differ by day category. However, cholesterol intake on non-schooldays

Table 1 Characteristics of children

	Schooldays		Non-schooldays*	
	<i>n</i>	%	<i>n</i>	%
All participants (<i>n</i> 2572)	(2034)		(538)	
Sex				
Male	1079	53	252	47
Female	955	47	286	53
Age groups (years)				
5–6	427	21	114	21
7–10	875	43	227	42
11–14	732	36	197	37
Ethnicity				
NZEO	641	32	153	28
Māori	794	39	174	32
Pacific	599	29	211	39
BMI category (kg/m ²)†				
Normal	1148	61	311	62
Overweight	468	25	120	24
Obese	272	14	74	15

NZEO, New Zealand European and others.

*Non-schooldays are weekends, national and school holidays.

†BMI category was not available for 179 children.

Table 2 Mean daily nutrient intake, by schooldays and non-schooldays

Nutrient	Schooldays		Non-schooldays		Coefficient	95% CI	P value*
	Mean	95% CI	Mean	95% CI			
Energy (kJ)	8298	8121, 8478	7915	7504, 8349	1.05	0.99, 1.11	0.131
Protein (g) ^a							
Normal weight	64	61, 66	63	60, 68	1.00	0.93, 1.08	0.975
Overweight	62	58, 66	69	62, 77	0.90	0.78, 1.03	0.111
Obese	71	66, 77	61	54, 68	1.17	1.02, 1.34	0.026
Total fat (g)	72	70, 74	70	66, 75	1.02	0.95, 1.10	0.557
Total SFA (g)	30	29, 31	30	28, 32	1.02	0.94, 1.11	0.694
Cholesterol (mg)	170	162, 177	189	173, 207	0.90	0.80, 1.00	0.049
Available carbohydrate (g)	262	256, 269	241	228, 254	1.09	1.02, 1.16	0.008
Starch (g)	143	139, 147	129	122, 136	1.11	1.04, 1.18	0.001
Sucrose (g)	54	52, 57	48	42, 54	1.14	1.01, 1.30	0.041
Fructose (g) ^b							
NZEO	13.2	11.8, 14.9	14.1	12.3, 16.1	0.94	0.80, 1.10	0.456
Māori	15.1	13.9, 16.5	14.5	12.4, 17.0	1.04	0.88, 1.24	0.620
Pacific	15.5	14.2, 17.0	10.8	9.0, 12.8	1.44	1.19, 1.74	0.000
Maltose (g)	2.8	2.7, 3.0	2.2	1.9, 2.5	1.28	1.10, 1.48	0.001
Glucose (g) ^b							
NZEO	12.6	11.3, 14.0	13.7	12.0, 15.7	0.92	0.79, 1.07	0.256
Maori	14.1	12.8, 15.4	14.1	12.1, 16.6	0.99	0.83, 1.18	0.941
Pacific	13.7	12.4, 15.1	9.8	8.2, 11.7	1.40	1.19, 1.66	0.000
Lactose (g)	7.0	6.2, 8.0	5.6	4.5, 7.0	1.25	0.99, 1.58	0.056
Dietary fibre (g)	17	16, 17	15	14, 16	1.11	1.02, 1.21	0.013
Calcium (mg)	583	556, 612	548	508, 591	1.06	0.98, 1.15	0.131
Iron (mg)	10	10, 10	10	9, 10	1.05	0.98, 1.12	0.148
Zinc (mg)	8.8	8.5, 9.1	8.9	8.3, 9.5	0.99	0.92, 1.07	0.822
Vitamin C (mg) ^a							
Normal weight	68	62, 75	55	46, 65	1.24	1.01, 1.52	0.040
Overweight	61	54, 70	67	54, 85	0.91	0.70, 1.19	0.489
Obese	78	66, 91	54	43, 68	1.45	1.06, 1.98	0.020
Vitamin A (µg)	454	431, 479	443	407, 483	1.02	0.93, 1.13	0.621
Retinol (µg)	252	239, 265	243	221, 266	1.04	0.93, 1.15	0.489
β-Carotene equivalents (µg)	771	716, 830	738	638, 853	1.04	0.88, 1.23	0.607
Riboflavin (mg)	1.4	1.3, 1.5	1.3	1.2, 1.4	1.08	0.98, 1.20	0.101

Significant interaction between the effect of day category and BMI category^a and ethnicity^b.

Nutrient intake is log transformed for skewness; data are presented as geometric means.

*Linear regression controlled for ethnicity, age, sex, New Zealand Index of Deprivation (NZDep01), BMI category, adjusted for survey weighting.

was slightly higher than on schooldays. The available carbohydrate, starch, sucrose and dietary fibre intakes were higher on schooldays than on non-schooldays (Table 2).

There was an interaction between BMI category and the effect of day category on vitamin C intake and on protein intake. Mean protein intake was higher on schooldays for obese children, but did not differ significantly by day category for normal/overweight. Obese children had higher vitamin C intake on non-schooldays, but intake by normal/overweight did not differ by day category. There was an interaction between ethnicity and day category on fructose and glucose intake; intakes were lower on non-schooldays for Pacific children, but did not differ significantly by day category for NZEO/Māori children.

Food groups

Table 3 lists all food groups in which at least 10% of children consumed an item from the food group by day category, and presents the proportion of consumers of selected food groups. On schooldays, children were more likely to consume sandwiches, biscuits/crackers and fruit than on non-schooldays.

There was a difference in the effect of day category on snack foods consumption, by ethnicity; while all ethnicities had a greater likelihood of consuming snack foods on a schoolday than a non-schoolday, the effect was more pronounced for Māori children.

There was a difference by day category in the consumption of snack bars by BMI category. Prevalence of intake did not differ by day category for overweight children, but snack bar consumption was higher on schooldays for normal and obese children.

On non-schooldays, more children consumed confectionery compared with schooldays. Hot chips consumption did not differ by day category for Pacific children, but more NZEO/Māori children consumed hot chips on non-schooldays than on schooldays.

There was a difference by day category on soft drink consumption, by ethnicity. There was no difference for Pacific children; NZEO/Māori children were less likely to have soft drinks on schooldays.

There was no difference in the odds of consuming pies/sausage rolls, cakes/muffins/puddings or ice cream by day category.

Table 3 Proportion of children consuming selected food groups by day category and the OR for schoolday consumption

Food group	Schooldays		Non-schooldays		OR	95 % CI	P value*
	Proportion	95 % CI	Proportion	95 % CI			
Milk	0.66	0.63, 0.69	0.63	0.57, 0.69	1.13	0.84, 1.52	0.415
Meat dishes	0.53	0.51, 0.56	0.59	0.53, 0.65	0.78	0.58, 1.04	0.086
Cakes/muffins/puddings	0.28	0.25, 0.30	0.32	0.26, 0.38	0.83	0.61, 1.14	0.254
Hot drinks	0.22	0.19, 0.24	0.19	0.15, 0.23	1.18	0.85, 1.64	0.321
Hot chips ^a							
NZEO	0.20	0.16, 0.24	0.33	0.25, 0.42	0.50	0.32, 0.77	0.002
Māori	0.21	0.17, 0.25	0.34	0.26, 0.43	0.51	0.32, 0.82	0.005
Pacific	0.25	0.21, 0.30	0.27	0.20, 0.35	0.89	0.61, 1.28	0.520
Pies/sausage rolls	0.21	0.17, 0.25	0.18	0.14, 0.24	1.16	0.75, 1.79	0.495
Ice cream	0.17	0.14, 0.19	0.20	0.15, 0.26	0.80	0.55, 1.16	0.233
Snack bars ^b							
Normal weight	0.18	0.15, 0.21	0.05	0.03, 0.08	4.26	2.52, 7.21	0.000
Overweight	0.16	0.11, 0.21	0.11	0.05, 0.23	1.48	0.56, 3.9	0.423
Obese	0.14	0.09, 0.22	0.01	0.00, 0.04	—†	—	—
Yoghurt/dairy snacks	0.16	0.13, 0.18	0.10	0.07, 0.15	1.63	0.97, 2.71	0.063
Bread-based dishes	0.14	0.12, 0.16	0.17	0.14, 0.22	0.76	0.55, 1.04	0.087
Sausage/processed meats	0.13	0.11, 0.16	0.16	0.13, 0.21	0.79	0.54, 1.15	0.212
Nuts/seeds	0.12	0.11, 0.14	0.12	0.09, 0.17	0.99	0.65, 1.50	0.945
Fish/seafood	0.12	0.10, 0.14	0.12	0.08, 0.17	0.97	0.62, 1.52	0.894
Egg dishes	0.10	0.08, 0.12	0.14	0.10, 0.19	0.67	0.44, 1.03	0.070
Bread‡	0.56	0.53, 0.59	0.62	0.56, 0.67	0.77	0.58, 1.02	0.066
Sandwiches	0.55	0.50, 0.59	0.30	0.24, 0.37	2.79	2.04, 3.82	0.000
Breakfast cereal‡	0.48	0.44, 0.51	0.42	0.36, 0.48	1.27	0.93, 1.71	0.128
Grains/pastat	0.38	0.36, 0.41	0.41	0.35, 0.47	0.91	0.67, 1.24	0.547
Potato/kumara/tarot‡	0.33	0.31, 0.36	0.31	0.26, 0.37	1.10	0.81, 1.49	0.553
Biscuits/cracker‡§	0.52	0.49, 0.55	0.41	0.34, 0.48	1.60	1.15, 2.23	0.005
Sugar/jams/syrups§	0.57	0.54, 0.60	0.52	0.46, 0.57	1.25	0.95, 1.64	0.109
Confectionery§	0.31	0.28, 0.34	0.41	0.34, 0.48	0.67	0.48, 0.93	0.016
Fruit‡§	0.68	0.65, 0.70	0.51	0.44, 0.58	1.99	1.41, 2.80	0.000
Powdered drinks/cordials‡§	0.41	0.38, 0.44	0.42	0.36, 0.48	0.95	0.70, 1.28	0.729
Soft drinks§ ^a							
NZEO	0.28	0.23, 0.34	0.41	0.30, 0.53	0.56	0.34, 0.94	0.028
Māori	0.33	0.28, 0.38	0.49	0.40, 0.58	0.51	0.34, 0.79	0.002
Pacific	0.41	0.37, 0.46	0.40	0.31, 0.49	1.06	0.71, 1.58	0.767
Snack foods‡ ^a							
NZEO	0.57	0.51, 0.62	0.39	0.30, 0.48	2.06	1.32, 3.21	0.002
Māori	0.60	0.55, 0.65	0.28	0.20, 0.36	3.92	2.58, 5.94	0.000
Pacific	0.50	0.44, 0.55	0.33	0.23, 0.44	2.04	1.22, 3.42	0.007
Vegetables‡ ^c							
Boys	0.38	0.33, 0.42	0.31	0.24, 0.39	1.37	0.9, 2.08	0.145
Girls	0.38	0.34, 0.43	0.45	0.36, 0.53	0.77	0.51, 1.15	0.200

Significant interaction between the effect of day category and ethnicity^a, BMI category^b and sex^c (see text).

*Logistic regression controlled for ethnicity, age, sex, New Zealand Index of Deprivation (NZDep01), BMI category, adjusted for survey weighting.

Collectively contribute †64 % daily starch, †67 % daily vitamin C, §65 % daily sucrose, ||57 % daily fructose.

†Just one child in the obese category on a non-schoolday consumed a snack bar.

Discussion

To our knowledge, this is the first study to compare the intake of food and nutrients between schooldays and non-schooldays in a nationally representative sample of children. Despite differences in the proportion of consumers of some food groups between schooldays and non-schooldays, the majority of nutrient intakes (including energy) did not differ by day category.

The intake of carbohydrate was lower on non-schooldays. Sucrose intake was lower perhaps because fewer children consumed fruit and biscuits/crackers on non-schooldays, or because there was a difference in the quantity of sucrose-rich items being consumed. Sucrose

intake on non-schooldays was lower despite 10% more children consuming confectionery.

Fruit was consumed by more children on schooldays, contributing to the greater fructose and vitamin C intake on schooldays. Other food items more commonly consumed on schooldays included sandwiches, snack foods and snack bars. An Australian survey found similar items in children's lunchboxes; typically containing 'about one sandwich, two biscuits, a piece of fruit, a snack of either a muesli/fruit bar or some other packaged snack'⁽¹⁴⁾. The most significant contributors to NZ children's energy intakes on schooldays (09.00–12.00 hours) were snack foods (22%) and biscuits (20%); at lunchtime, sandwiches (33%) and fruit (12%)⁽⁵⁾. These data support 84%

of children's statements that they bring 'most' of their food consumed at school from home⁽⁹⁾, as in Australia⁽¹⁶⁾.

Consumption of 'unhealthy' foods is ubiquitous. For Australian children, fast foods, including hot chips and pies/sausage rolls, contributed ~10% energy at school and 11.8% out of school⁽¹⁵⁾. In NZ, the 'villains' of the tuck shop are considered to include pies/sausage rolls, hot chips and soft drinks/sweetened beverages. However, these are just as likely to be consumed on a non-schoolday. Hot chips are twice as likely to be consumed on a non-schoolday, and intake during school hours is negligible⁽¹⁶⁾. Soft drinks and other sweetened beverages are considered to contribute to obesity⁽¹⁷⁾, but as the intake of powdered drinks/cordials did not vary by day category, and soft drink consumption was higher on non-schooldays for Māori/NZEO, the issues could not be adequately addressed by focusing solely on foods available on the school premises. This is in spite of the strenuous efforts by health professionals to encourage schoolchildren to choose water or milk to drink. It appears that, in agreement with previous research, children obtain or choose the foods that they prefer and foods that are readily available at home, and foods that they and their families and/or peers find convenient and affordable⁽¹⁸⁾. The data presented indicate that a hungry child in search of hot food in NZ, whether on a schoolday or non-schoolday, can more readily access hot chips or a pie than soup or a rice-based dish. In order to influence the food choices and nutrition of NZ schoolchildren, affordable and accessible food alternatives need to be available at home, in shopping malls and convenience stores and in school tuck shops. Pasta and rice-based dishes need to be stored in home refrigerators, sold in the context of fast-food outlets and as part of the offerings in the school environment. This has the potential to increase intakes of calcium and vitamin A among schoolchildren without increasing energy or fat intake.

The present study has some limitations: the classification of food groups means that the prevalence of consumption of some foods may be under-reported. For example, vegetable/meat/cheese fillings in sandwiches will not be counted. It is difficult to compare consumption within 'school hours' between day categories because patterns of consumption throughout the day are likely to vary, particularly in the oldest age group. For example, many teenagers may rise later on non-schooldays. While distribution of children's characteristics (sex, ethnicity) varies by day category, this is accounted for in the regression.

Altering the school environment is one avenue to effect a positive change in children's diets. However, as only approximately one-third of a child's daily energy intake is consumed during school hours^(5,15) this is only a partial solution. The public health focus has been on the foods consumed by children at school, with emphasis on the regulation of foods sold at school tuck shops/canteens.

Schools can influence on-site provision and policies can affect food choice such as prohibiting leaving school grounds during school hours. Schools may provide guidance on what may or may not be brought to school. However, the present study reinforces the fact that the family environment and what is provided from home is the mainstay of nutrition for NZ children. Where improvement is needed to children's diets, attention must be made to the foods provided by parents, regardless of where they are consumed. Parents who are time constrained need to be able to provide for their children, directly or indirectly, a wider range of hot food items.

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Appendix

Food group definitions*

Food group	Examples
Milk	Cow, soya, flavoured, shakes, powder
Snack foods	Potato crisps, corn chips, vegetable/grain crisps, popcorn, extruded snacks
Meat dishes	Poultry, beef, lamb, pork, offal
Cakes/muffins/puddings	Also slices, scones, pancakes, pastries, milk puddings, desserts
Hot drinks	Chocolate, cereal beverages; excludes tea/coffee
Hot chips	Fries, wedges, croquettes/hash browns
Pies/sausage rolls	Meat pies, bacon egg pie, quiche
Ice cream	Regular, novelty, reduced-fat
Snack bars	Muesli, puffed cereal, nut/seed, breakfast cereal-based
Yoghurt/dairy snacks	Regular, reduced-fat, frozen, dairy 'food'
Bread-based dishes	Hotdogs, hamburgers, pizza, nachos
Sausage/processed meats	Luncheon, saveloys, meat-loaf/patties; excludes sausage rolls
Nuts/seeds	Peanut butter, Nutella™, coconut milk/cream
Fish/seafood	Canned, battered/crumbed, shellfish, fish/seafood dishes, products
Egg dishes	Omelettes, self-crusting quiches
Bread	All types: rolls, pita, bagels, crumpets, sweet buns
Sandwiches	Filled rolls, pita, croissants
Breakfast cereals	Muesli, wheat biscuits, porridge, puffed/flakes/extruded cereals
Grains/pasta	Rice, pasta, cereal-based dishes (lasagne)
Potato/kumara/taro	Mashed, boiled, baked, scalloped, stuffed (excludes crisps/fried potato)
Biscuits/crackers	Plain, coated, filled
Sugar/jams/syrups	Honey, jelly, sweet toppings, icing
Confectionery	Lollies/candy, gum, chocolate, ice-blocks
Fruit	Fresh, cooked, canned, dried
Powdered drinks/cordials	Fruit-flavoured
Soft drinks	Carbonated, sports/energy drinks
Vegetables	All vegetables (except potato/kumara/taro), legumes/pulses, dishes

*Full list in Parnell *et al.*⁽⁹⁾