

# Secular changes in intakes of foods among New Zealand adults from 1997 to 2008/09

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## Abstract

**Objective:** To examine changes in the food choices of New Zealand (NZ) adults, between the 1997 National Nutrition Survey (NNS97) and the 2008/09 NZ Adult Nutrition Survey (2008/09 NZANS).

**Design:** The 2008/09 NZANS and the NNS97 were cross-sectional surveys of NZ adults (aged 15 years and over). Dietary intake data were collected using a computer-based 24 h diet recall. Logistic regression models were used to examine changes over time in the percentage reporting each food group, with survey year, sex and age group (19–30 years, 31–50 years, 51–70 years, ≥71 years) as the variables.

**Setting:** NZ households.

**Subjects:** Adults aged 19 years and over (NNS97, *n* 4339; 2008/09 NZANS, *n* 3995).

**Results:** In the 2008/09 NZANS compared with NNS97, males and females were less likely to report consuming bread, potatoes, beef, vegetables, breakfast cereal, milk, cheese, butter, pies, biscuits, cakes and puddings, and sugar/confectionery (all  $P < 0.001$ ). In contrast, there was an increase in the percentage reporting rice and rice dishes ( $P < 0.001$ ), and among females a reported increase in snacks and snack bars (e.g. crisps, extruded snacks, muesli bars;  $P = 0.007$ ) and pasta and pasta dishes ( $P = 0.017$ ). Although food choices were associated with sex and age group, there were few differential changes between the surveys by sex or age group.

**Conclusions:** For all age groups there was a shift in the percentage who reported consuming the traditional NZ foods, namely bread, beef, potatoes and vegetables, towards more rice and rice dishes. Declines in the consumption of butter, pies, biscuits, cakes and puddings are congruent with current dietary guidelines.

**Keywords**  
Food consumption  
New Zealand  
Trends  
Food intake  
National nutrition survey  
2008/09 NZANS  
NNS97

Many factors contribute to changes in the dietary habits of a population including technological changes, urbanization, trade agreements, cultural shifts and public health campaigns. Globalization of the food supply and increased centralization have been described as both increasing and reducing dietary diversity<sup>(1,2)</sup>. The ‘burgerization’ or ‘systematic moulding of tastes’ described by Lang has occurred concurrently with an increased uptake of local specialties and ethnic cuisines<sup>(1)</sup>. Specifically in New Zealand (NZ), closer trade relations with Australia have made available to this population a wider range of foods. Furthermore, the NZ population has become more ethnically diverse, and with increased travel opportunities and faster communication, international influences are more prevalent.

Examining trends in food consumption patterns is essential to anticipate future diet-related health issues

and provide an evidence base for future public health initiatives<sup>(3)</sup>. It is important that the NZ food-based dietary guidelines reflect current food patterns.

Both the 2008/09 New Zealand Adult Nutrition Survey (2008/09 NZANS) and the 1997 National Nutrition Survey (NNS97) provide detailed information on the dietary intakes of a sample of adults<sup>(4,5)</sup> with calibration weights available to reflect the NZ population at the time. Both used 24 h diet recall and similar analytical methods including food group coding. The first objective of the present study was to ascertain what changes have occurred over the last decade in the food choices of NZ adults and the second was to determine whether these changes differed by sex and age group. The third objective was to describe sex and age group variation in the food choices of the 2008/09 NZANS participants. This research will

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provide an insight into key trends with respect to food group choices in NZ.

## Methods

### **Study design and participants**

The 2008/09 NZANS (*n* 4721) and the NNS97 (*n* 4636) were cross-sectional surveys of nationally representative samples of NZ adults (aged 15 years and above) with area-based sampling frames and oversampling of Māori and Pacific in both surveys<sup>(4)</sup>. In the 2008/09 NZANS there was also oversampling of two age groups (15–18 years and 71 years and over). Participants for the NNS97 were recruited from a sub-sample of the 1996/97 NZ Health Survey with an overall response rate of 50%. The sample frame used for the NZ Health Survey had three stages. First, meshblocks (primary sampling units) were selected from fourteen geographically defined regions. Meshblocks are geographical units of approximately sixty-five dwellings, defined by Statistics New Zealand. Second, a random sample of households was taken within each meshblock and third, within each household a single participant was selected. Data were collected between December 1996 and November 1997<sup>(5)</sup>.

For the 2008/09 NZANS, a three-stage sample design was used with a response rate of 61%. The sampling frame was also three stages; in the first stage meshblocks (primary sampling units) were stratified into twenty-one District Health Boards and selected to ensure geographical representation. Meshblocks can vary in size and were therefore selected proportional to size (with larger meshblocks more likely to be selected). In the second stage a random sample of seven households were selected from each meshblock, an additional twenty dwellings were also selected to screen for Māori, Pacific and the age groups 15–18 years and 71 years and over. Third, one participant from each household was randomly selected. Data were collected between October 2008 and October 2009. We have restricted analyses presented here to adults aged 19 years or more. Full details of methods and designs of the NNS97 and the 2008/09 NZANS are available<sup>(4,5)</sup>.

Informed consent was obtained from all participants. Ethical approval for the 2008/09 NZANS was granted from the Health and Disability Multi-Region Ethics Committee of NZ<sup>(6)</sup> and ethical approval for the NNS97 was granted from fourteen ethics committees throughout NZ<sup>(5)</sup>.

### **Twenty-four hour diet recall**

A computer-based multiple-pass 24 h diet recall was used for the collection of dietary intake data for both surveys. The recall software was updated between surveys to accommodate changes to the food supply. Interviews for both surveys took place within participants' homes<sup>(6)</sup>. A second 24 h diet recall was collected on a sub-sample of participants for both 2008/09 NZANS (25%) and NNS97

(15%); however, for the present analyses only the first 24 h diet recall was used. In the initial stage of the diet recall, a 'quicklist' of all foods, beverages and dietary supplements was collected. In the second and third stages of the recall a detailed description of all foods and beverages was collected with information on the amounts consumed. Finally, in the fourth stage the foods were reviewed in chronological order and additions and changes made to the diet recall as necessary. Further details are available elsewhere<sup>(5,6)</sup>.

### **Food group classification**

For each survey, all foods and beverages reported were coded to thirty-three main food groups. The food group coding scheme was similar for the two surveys, although in the 2008/09 NZANS some sub-food groups were added to allow for new foods<sup>(6)</sup>. Table 1 shows the classification of food groups used for the current research.

In both surveys participants who reported mixed savoury dishes (e.g. casseroles, stir-fries), bread-based dishes (e.g. sandwiches and hamburgers) and salads were asked to report the recipe (both ingredients and amounts). If this was known, the ingredients were coded into separate food groups. For example, for a tomato sandwich, the bread would be coded into the bread food group, the margarine into margarine, the tomato into vegetables. However, if a participant was unable to report all detail of the ingredients, a description of the food was collected and it was coded according to the main food component. For example, a cheeseburger was coded into the sub-food group burgers and hotdogs within the main food group of bread-based dishes. The food group fats and oils captures fats (excluding butter or margarine/table spreads) used in cooking as part of a recipe and fats and oils added to food before consumption (e.g. an olive oil dip).

### **Statistical analysis**

Data were analysed using the statistical software package Stata version 12.1. The data from the two surveys were combined and survey-specific sample weights were used to produce estimates that represented each population at the time of that survey<sup>(7)</sup>. The analytical sub-population excluded participants aged 15–18 years, so the final sample consisted of 8334 people (NNS97, *n* 4339; 2008/09 NZANS, *n* 3995). While participants may have been included in both samples, it was not possible to identify any such cases and the frequency of this should be relatively low as each sample included 1.2–1.5% of the eligible population.

To match groups reported previously, age was categorized into four groups (19–30 years, 31–50 years, 51–70 years, ≥71 years)<sup>(4)</sup>.

To examine changes in the percentage reporting each food group between the two surveys, logistic regression models were created with survey (2008/09 NZANS or NNS97), sex and age group (as described above) entered

**Table 1** Classification of food groups†

Food group	Foods included
Bread	All types of bread (rolls, pita, foccacia, garlic), bagels, crumpets, sweet buns
Bread-based dishes	Sandwiches, filled rolls, hamburgers, hotdogs, pizza, nachos, donor kebabs, wontons, spring rolls, bread stuffing
Pasta and pasta-based dishes‡	All pasta, pasta and sauce, lasagne, pasta salad, noodle soup, chow mein
Rice and rice-based dishes‡	Boiled, fried, risotto, sushi, salad
Potatoes	Mashed, boiled, baked potatoes and kumara (sweet potato), hot chips, hash browns, wedges, potato dishes (stuffed, scalloped potatoes), taro roots and stalks
Breakfast cereals	All types including muesli, wheat biscuits, porridge, puffed/flaked/extruded cereals
Fruit	All fruit, fresh, canned, cooked and dried
Vegetables	All vegetables (fresh, frozen, canned) including mixes, coleslaw, tomatoes, green salads, legumes and pulses, legume products and dishes (baked beans, hummus, tofu), vegetable dishes
Milk	All milk (cow, soya, rice, goat and flavoured milk), milkshakes, milk powder
Cheese	Cheddar, edam, specialty (blue, brie, feta, etc.), ricotta, cream cheese, cottage cheese, processed cheese
Dairy products	Cream, sour cream, yoghurt, dairy food, ice cream, dairy-based dips
Eggs	Poached, boiled, scrambled and fried eggs, omelettes, self-crusting quiches, egg stir-fries
Butter	Butter, butter/margarine blends
Margarine	Margarine, reduced-fat spreads
Fats and oils§	Canola, olive, sunflower and vegetable oils, dripping, lard
Lamb and mutton	All muscle meats (chops, roast, mince, etc.), stews, stir-fries, curries
Beef	All muscle meats (steak, mince, corned beef, roast, schnitzel, etc.), stews, stir-fries
Pork	All muscle meats (roast, chop, steak, schnitzel, etc.), bacon, ham, stews, stir-fries
Poultry	All chicken, duck, turkey and muttonbird muscle meats and processed meat, stews and stir-fries
Fish and seafood	All fish (fresh, frozen, smoked, canned, battered, fingers, etc.), shellfish, squid, crab, fish/seafood dishes (pies, casseroles and fritters), fish/seafood products
Pies	All pies including potato top, pasties, savouries, sausage rolls, quiche with pastry
Sausages and processed meat	Sausages, luncheon, frankfurters, salami, meatloaf and patties
Other meat	Venison, rabbit, goat, liver (lamb's fry), pâté (liver), haggis
Biscuits	Sweet biscuits (plain, chocolate coated, fruit filled, cream filled), crackers
Cakes and muffins	All cakes and muffins, slices, scones, pancakes, doughnuts, pastry
Puddings	Milk puddings, cheesecake, fruit crumbles, mousse, steamed sponges, sweet pies, pavlova, meringues
Sugar and confectionery	Sugars, syrups, confectionery, chocolate, jam, honey, jelly, sweet toppings and icing, ice-confectionery, artificial sweeteners
Nuts and seeds	Peanuts, almonds, sesame seeds, peanut butter, chocolate/nut spreads, coconut (including milk and cream), nut-based dips (pesto)
Snacks and snack bars	Potato crisps, corn chips, popcorn, extruded snacks, grain crisps, muesli bars, wholemeal fruit bars, puffed cereal bars, nut and seed bars
Sauces	Gravy, tomato and cream-based sauces, soya, tomato and other sauces, cheese sauces, mayonnaise, oil and vinegar dressings, chutney, marmite
Soup	All instant and homemade soups (excluding noodle soups), stocks and stock powder
Alcoholic beverages	Wine, beer, spirits, liqueurs and cocktails, ready-to-drink alcoholic sodas (RTD)
Water	Water
Hot beverages	All teas, coffee and substitutes, hot chocolate drinks
Juice	Fruit or vegetable juice
Sweetened beverages	Cordial, soft drinks, fruit-flavoured drinks, powdered drinks, sports and energy drinks

†Adapted from 2008/09 New Zealand Adult Nutrition Survey methodology report<sup>(6)</sup>.

‡Previously, rice and rice dishes and pasta and pasta dishes were reported together as 'grains and pasta'.

§Captures fats and oils used in cooking when recipes were reported and fats and oils added before eating, e.g. olive oil.

as independent variables. The adjusted percentage of participants who reported each food group, stratified by sex and age group, was estimated using the 'margins' command in Stata 12.1. To examine differential changes by sex and age group, a three-way interaction was entered into the model: sex × age group × survey. Interaction effects for survey × sex were tested within each age group and for survey × age group within males and females separately. Contrasts were conducted to test for: (i) differences between NNS97 and the 2008/09 NZANS for all males and females; and then (ii) within each sex and age group. For the 2008/09 NZANS only, contrasts were conducted to test: (i) differences between males and females overall and within each age group; and (ii) differences by age group. Two-sided *P* values <0.05 were considered

statistically significant in all cases. As this was an exploratory study, no adjustments were made for multiple comparisons and marginal results should be interpreted with caution. The difference between the surveys has been calculated as the percentage reporting the food group in the 2008/09 NZANS minus the percentage reporting the food group in the NNS97 so that positive differences reflect increases in consumption. The contribution to total daily energy from each food group was also calculated.

### Sensitivity analysis

To examine whether the removal of low energy reporters altered our results, a sensitivity analysis was completed. Participants with a ratio of energy intake to estimated

resting metabolic rate ( $EI:RMR_{est}$ ) of  $<0.9$  were classified as low energy reporters. The method used to identify low energy reporters was consistent with that used by Pikhholz *et al.*<sup>(8)</sup> and Gemming *et al.*<sup>(9)</sup>, with specific equations from Swinburn *et al.* used for NZ Māori and Pacific ethnic groups to estimate fat mass from BMI and  $RMR_{est}$ <sup>(10)</sup>. Participants with incomplete data for weight and height, and those of non-European ethnicity within the derived NZ European and Others ethnic group were excluded from the sensitivity analysis.

## Results

Table 2 shows the demographic characteristics of the 2008/09 NZANS and NNS97 participants. In the 2008/09 NZANS, there was a greater proportion of people in the 51–70 year age group compared with NNS97 reflecting a population-level increase in age<sup>(11)</sup>.

The percentage of mixed dishes within the meat food group, for which participants were unable to report ingredients and amounts of each ingredient, almost doubled between the two surveys (Fig. 1).

### Trends in percentage reporting food groups

Tables 3 and 4 show for males and females the percentage of participants reporting the consumption of each food group in the 2008/09 NZANS and the difference (expressed as

**Table 2** Characteristics of adults (aged 19 years and over) sampled in the New Zealand national nutrition surveys: NNS97 and the 2008/09 NZANS

	NNS97 (n 4339)		2008/09 NZANS (n 3995)		P†
	%†	SE	%	SE	
<b>Males</b>	48.0	1.1	47.9	1.2	0.932
Age group					
19–30 years	24.0	1.5	20.9	1.6	
31–50 years	43.6	1.5	39.5	1.8	
51–70 years	24.3	1.3	29.7	1.6	
≥71 years	8.2	0.8	9.9	0.7	0.014
Ethnicity					
NZEO	85.3	1.0	85.3	1.0	
Māori	10.7	1.0	10.3	0.9	
Pacific	4.0	0.5	4.5	0.4	0.740
<b>Females</b>	51.9	1.1	52.1	1.2	
Age group					
19–30 years	23.8	1.3	19.0	1.3	
31–50 years	42.3	1.3	40.9	1.6	
51–70 years	23.2	1.1	28.8	1.4	
≥71 years	10.8	0.8	11.3	0.7	0.003
Ethnicity					
NZEO	84.9	0.8	84.5	1.0	
Māori	11.1	0.7	10.9	0.8	
Pacific	3.9	0.4	4.5	0.4	0.647

NNS97, 1997 National Nutrition Survey; 2008/09 NZANS, 2008/09 New Zealand Adult Nutrition Survey; NZEO, New Zealand European and Others.

†Weighted percentage.

‡From the  $\chi^2$  test.

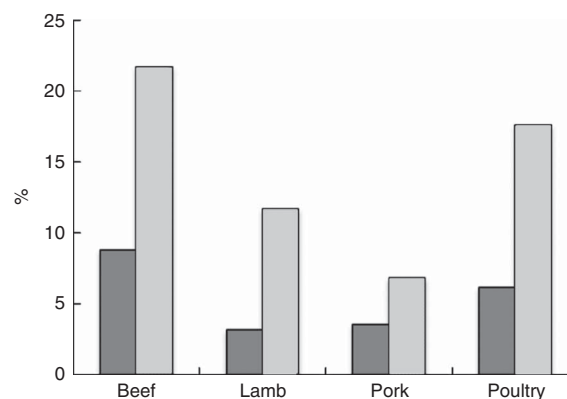
percentage points) from the NNS97. Overall for males and females, there was no evidence of a change in the percentage reporting the following food groups: bread-based dishes; fruit; dairy products; eggs; pork; fish and seafood; sausages and processed meat; nuts; juice; and sweetened beverages (all  $P > 0.05$ ).

Between the NNS97 and the 2008/09 NZANS, the percentage of participants reporting the consumption of bread, potatoes and breakfast cereals decreased for both males and females ( $P < 0.001$ ). For potatoes and breakfast cereals the decrease within the age group 31–50 years was greater for males than females (survey  $\times$  sex interactions: potatoes,  $P = 0.006$ ; breakfast cereals,  $P = 0.031$ ). In contrast, for both males and females there was an increase in the percentage who reported rice and rice dishes (males, +8.7%; females, +5.9%,  $P < 0.001$ ), and for females only there was an increase in the percentage reporting pasta and pasta dishes (+3.6%,  $P = 0.017$ ).

There was a decrease of approximately 10% in all age groups for males and females (apart from those aged 19–30 years and males aged  $\geq 71$  years) who reported consuming vegetables ( $P < 0.001$ ). Furthermore, there was a decrease between the two surveys in the percentage who reported consuming milk and cheese (each  $P < 0.001$ ).

The percentage of males and females reporting butter nearly halved in the 12-year period. There was evidence of a differential change in the consumption of fats and oils by age group (survey  $\times$  age group interaction: males,  $P = 0.016$ ; females,  $P = 0.025$ ). An increase was found for males aged 19–30 years (+11%,  $P < 0.001$ ) and males aged  $\geq 71$  years (+4.5%,  $P = 0.009$ ) but no evidence of change in the middle age groups. Among females there was an increase in the percentage reporting the consumption of fats and oils for those aged 51–70 years (+7.4%,  $P < 0.001$ ) but no significant change in the other age groups.

For females the percentage who reported both beef (difference:  $-8.0\%$ ,  $P < 0.001$ ) and lamb ( $-2.5\%$ ,  $P = 0.032$ ) decreased and beef also declined for males



**Fig. 1** Percentage of mixed dishes, not reported as recipes, within meat food groups consumed by adults aged 19 years and over in the 1997 National Nutrition Survey (■; n 4339) and the 2008/09 New Zealand Adult Nutrition Survey (□; n 3995)

**Table 3** Percentage of males reporting each food group in the 2008/09 NZANS and difference from the NINS97 by age group

Food group	All				19–30 years			31–50 years			51–70 years			≥71 years		
	2008/09 NZANS (%)†	Diff.‡	P§	2008/09 NZANS (%)	Diff.	P	2008/09 NZANS (%)	Diff.	P	2008/09 NZANS (%)	Diff.	P	2008/09 NZANS (%)	Diff.	P	PI
Bread	73.9	-11.9	<0.001	67.0	-12.8	0.016	75.4	-11.2	<0.001	73.8	-13.2	0.002	82.5	-13.2	0.004	*
Bread-based dishes	24.6***	3.9	0.189	33.3**	7.1	0.187	25.4*	3.7	0.234	22.2**	6.3	0.082	10.3	-2.5	0.513	***
Pasta & pasta dishes	18.5	2.4	0.227	25.3	3.3	0.497	19.6	3.2	0.256	15.1	3.1	0.324	9.4	0.1	0.980	***
Rice & rice dishes	20.7	8.7	<0.001	25.2	9.3	0.090	23.7	9.5	0.001	18.1	11.6	0.009	9.2	5.4	0.130	***
Potatoes¶	48.9	-15.1	<0.001	41.9	-13.3	0.026	44.3	-18.0	<0.001	54.0**	-16.9	<0.001	67.6	-10.0	0.037	***
Breakfast cereals¶	35.9	-9.1	<0.001	29.3	-6.3	0.248	29.1	-12.2	<0.001	44.9*	-7.1	0.110	50.6	-20.2	<0.001	***
Fruit	55.8***	-1.2	0.283	47.5	2.5	0.645	52.5**	-6.2	0.094	61.2**	2.2	0.625	70.0***	-7.5	0.102	***
Vegetables	68.5	-10.3	<0.001	61.4	-5.5	0.320	66.6	-13.6	<0.001	73.3	-12.0	0.001	76.8	-9.6	0.102	**
Milk	77.7	-11.0	<0.001	68.9	-16.3	<0.001	81.9	-6.9	0.007	77.3	-13.6	<0.001	86.7**	-5.7	0.106	***
Cheese	26.7*	-9.2	<0.001	27.0	-10.8	0.039	28.2	-7.8	0.032	24.3	-11.7	0.007	26.7	-3.2	0.526	**
Dairy products	29.5	-0.5	0.296	20.7	-3.9	0.400	29.0	-0.7	0.877	34.5	3.2	0.453	35.0	-8.3	0.132	**
Eggs	22.3	1.3	0.601	17.0	-0.6	0.881	22.7	0.3	0.925	25.8	3.8	0.304	21.1	1.1	0.778	**
Butter	18.0	-22.6	<0.001	12.2	-26.3	<0.001	19.6	-23.7	<0.001	17.8	-19.7	<0.001	24.3	-17.3	<0.001	*
Margarine	48.1	5.1	0.077	42.2	8.6	0.112	46.0*	5.5	0.141	49.9	-2.0	0.660	63.0	5.1	0.349	***
Fats & oils¶	7.9	2.7	<0.001	14.8	11.0	<0.001	8.0	0.1	0.956	3.4**	0.6	0.688	6.2	4.5	0.009	*
Lamb	6.8	-2.6	0.056	7.4	3.1	0.186	6.8	-3.3	0.115	6.7	-4.9	0.103	6.4	-7.7	0.006	*
Beef	23.0	-10.6	<0.001	20.3*	-9.1	0.068	24.4	-11.0	0.002	21.7	-14.2	<0.001	26.6	-3.4	0.474	**
Pork	23.3	-3.5	0.478	25.8*	1.4	0.775	20.3	-9.5	0.005	24.6	-0.1	0.980	25.9	1.9	0.716	***
Poultry	24.7	5.1	0.090	25.1	2.6	0.590	28.4	7.0	0.029	23.0	6.4	0.073	13.9	3.6	0.257	***
Fish & seafood	17.9*	-2.1	0.074	10.6	-5.2	0.119	19.3	-3.2	0.583	19.3	0.6	0.860	17.0	-5.6	0.153	*
Pies	13.5***	-10.1	<0.001	20.1**	-11.6	0.024	13.2*	-10.7	<0.001	11.0	-7.2	0.025	8.6	-6.2	0.047	**
Sausages	17.4*	1.5	0.623	17.2	0.9	0.811	20.0*	2.4	0.423	15.8	2.7	0.382	12.4	-2.2	0.566	***
Biscuits	27.8**	-9.4	<0.001	16.6	-7.1	0.140	27.1*	-10.9	0.002	30.9	-10.2	0.020	44.7	-15.8	0.002	***
Cakes	24.3	-5.4	0.003	14.8	-9.6	0.043	24.9	-2.9	0.404	27.4	-7.4	0.088	32.8	-7.4	0.196	***
Puddings	6.7	-3.9	0.003	4.0	-5.8	0.055	6.2	-2.7	0.179	6.8	-4.9	0.049	13.7**	-4.1	0.325	***
Sugar & confectionery	68.0**	-15.8	<0.001	65.4	-13.9	0.011	68.6	-15.2	<0.001	66.7*	-18.7	<0.001	75.1***	-17.9	<0.001	***
Nuts	13.1	-2.7	0.235	12.0	-6.0	0.135	16.1	-1.3	0.641	10.2	-1.7	0.528	12.7	0.8	0.815	***
Snacks & snack bars¶	17.7	3.4	0.093	20.4	-5.3	0.265	16.1	3.3	<0.001	7.7	0.6	0.181	2.4	-1.7	0.507	***
Sauces	49.6	-14.2	<0.001	50.1	-16.0	<0.006	49.5	-14.8	<0.001	49.6	-12.6	0.007	48.4	-11.1	0.034	***
Soup	8.3*	-4.0	0.013	10.6	-0.7	0.836	5.1**	-5.3	0.005	7.2*	-7.1	0.014	20.0	1.0	0.797	***
Alcohol	36.2***	-4.8	0.166	34.8***	2.6	0.631	34.6*	-8.7	0.023	39.0**	-8.0	0.076	37.5***	1.1	0.993	***
Water	86.6*	6.4	<0.001	87.5	7.2	0.098	88.3	6.6	0.014	83.2	4.2	0.234	87.7	11.3	0.002	***
Hot beverages	84.9	-4.5	<0.001	65.2*	-7.6	0.155	86.3	-6.6	0.001	93.2	-3.3	0.076	96.0	-2.4	0.052	***
Juice	15.0	-0.9	0.720	15.8	-7.1	0.205	15.0	2.1	0.440	15.2	-2.0	0.549	12.6	1.8	0.596	***
Sweetened beverages	37.1**	-1.3	0.479	53.3*	-2.6	0.632	35.4	-2.8	0.412	26.1	-0.6	0.869	22.9*	8.7	0.046	***

2008/09 NZANS, 2008/09 New Zealand Adult Nutrition Survey; NINS97, 1997 National Nutrition Survey.

†Significant difference compared with females in 2008/09 NZANS: \* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ .

‡Difference from NINS97 as percentage points.

§ $P$  value for comparison between NINS97 and 2008/09 NZANS; significant  $P$  values indicated in bold font.

¶Significant relationship between prevalence of consumption and age group for 2008/09 NZANS: \* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ .  
 ¶Potatoes: sex x survey interaction,  $P = 0.006$ ; breakfast cereals: sex x survey interaction,  $P = 0.031$ ; fats & oils: age group x survey interaction,  $P = 0.016$ ; snacks & snack bars: age group x survey interaction,  $P = 0.032$ .

**Table 4** Percentage of females reporting each food group in the 2008/09 NZANS and difference from NNS97 by age group

Food group	All			19–30 years			31–50 years			51–70 years			≥ 71 years			
	2008/09 NZANS (%)†	Diff.‡	P§	2008/09 NZANS (%)	Diff.	P	2008/09 NZANS (%)	Diff.	P	2008/09 NZANS (%)	Diff.	P	2008/09 NZANS (%)	Diff.	P	PII
Bread	70.7	-14.3	<0.001	65.4	-12.7	<0.001	70.1	-14.0	<0.001	71.1	-17.9	<0.001	80.5	-14.1	<0.001	**
Bread-based dishes	15.3***	0.5	0.607	18.8**	-4.0	0.334	17.9*	3.5	0.158	11.7**	0.8	0.746	8.6	1.3	0.617	***
Pasta & pasta dishes	17.1	3.6	0.017	22.7	2.4	0.549	20.1	6.5	0.005	12.1	2.9	0.234	9.8	2.5	0.381	***
Rice & rice dishes	19.6	5.9	<0.001	25.5	7.8	0.034	19.5	3.5	0.163	19.1	9.6	0.001	9.7	3.3	0.110	***
Potatoes	48.7	-8.6	<0.001	46.1	-8.1	0.111	46.1	-5.0	0.141	49.0**	-14.4	<0.001	61.4	-13.9	0.001	***
Breakfast cereals	36.2	-4.0	0.001	26.3	-1.7	0.692	32.5	-1.9	0.529	42.7*	-9.5	0.021	49.3	-14.4	0.001	***
Fruit	66.5***	-2.8	0.054	57.0	-0.1	0.987	62.7**	-4.9	0.131	72.9**	-5.3	0.106	80.2***	-3.4	0.305	***
Vegetables	72.0	-9.5	<0.001	66.8	-4.4	0.337	69.6	-11.0	<0.001	77.2	-12.6	<0.001	76.7	-12.8	<0.001	**
Milk	77.7	-9.4	<0.001	70.1	-12.7	0.004	80.8	-7.6	0.001	78.2	-9.9	<0.001	78.4**	-11.2	0.003	**
Cheese	29.6*	-7.6	<0.001	22.4	-16.1	<0.001	32.2	-6.5	0.050	30.5	-4.9	0.19	29.9	-2.4	0.590	**
Dairy products	32.8	0.7	0.953	31.2	-0.1	0.983	27.9	0.0	0.923	38.0	1.9	0.649	40.0	-1.1	0.788	
Eggs	20.5	-1.6	0.721	25.5	7.0	0.096	17.2	6.0	0.023	21.5	-1.1	0.727	22.0	-2.0	0.619	
Butter	19.4	-21.3	<0.001	15.5	-24.1	<0.001	20.9	-18.9	<0.001	18.7	-25.2	<0.001	22.5	-17.0	<0.001	
Margarine	36.9	0.6	0.720	37.8	1.4	0.789	37.2*	-3.2	0.312	50.6	2.9	0.481	60.0	2.2	0.616	
Fats & oils¶	10.3	2.9	0.003	11.4	1.8	0.570	10.7	1.2	0.565	11.2**	7.4	<0.001	4.7	2.2	0.177	***
Lamb	6.6	-2.5	0.032	7.3	-2.2	0.445	4.7	-1.7	0.253	8.3	-4.6	0.05	8.6	-1.8	0.469	
Beef	21.0	-8.0	<0.001	12.1*	-12.5	0.001	23.3	-6.0	0.036	23.3	-9.3	0.013	21.6	-7.9	0.041	*
Pork	21.3	-0.9	0.766	16.3*	-4.2	0.308	23.8	0.8	0.798	20.3	-4.1	0.231	23.2	5.5	0.132	
Poultry¶	24.5	2.8	0.255	33.0	11.4	0.005	26.7	2.6	0.380	19.5	2.0	0.518	15.4	-5.9	0.086	
Fish & seafood	21.2*	0.4	0.659	16.0	-1.6	0.314	21.9	0.9	0.560	24.6	1.3	0.923	17.7	-3.9	0.743	
Pies	7.6***	-9.8	<0.001	9.5**	-11.8	0.001	7.9*	-11.9	<0.001	6.5	-6.6	0.003	6.2	-2.3	0.287	
Sausages	13.1*	2.1	0.220	14.8	1.9	0.595	13.1*	3.1	0.139	12.9	2.1	0.415	11.1	-0.2	0.951	
Biscuits	35.1**	-7.6	<0.001	26.1	-8.3	0.073	35.0*	-5.5	0.089	38.4	-9.5	0.022	42.3	-16.5	<0.001	
Cakes	26.3	-7.2	<0.001	22.4	-2.0	0.632	25.2	-11.4	<0.001	29.6	-4.9	<0.001	28.0	-11.6	0.006	
Puddings¶	6.7	-2.4	0.034	8.8	1.3	0.642	4.5	-4.7	0.007	8.2	0.8	0.714	7.6**	-8.0	0.002	
Sugar & confectionery¶	62.5**	-10.7	<0.001	69.8	-2.6	0.578	62.8	-9.6	0.002	57.9*	-13.5	<0.001	61.1***	-21.4	<0.001	
Nuts	15.0	1.3	0.761	9.5	-1.9	0.544	17.9	3.3	0.184	15.3	0.1	0.985	13.2	1.1	0.695	
Snacks & snack bars	18.6	4.6	0.007	23.2	2.8	0.422	21.5	-1.7	0.055	14.0	3.5	0.018	4.1	-1.6	0.289	
Sauces	53.2	-11.3	<0.001	52.3	-11.4	0.020	53.9	-10.4	0.002	54.8	-12.5	0.001	48.2	-13.2	0.003	***
Soup	12.0*	-2.5	0.098	9.9	-3.8	0.020	10.7**	-1.4	0.525	13.0*	-5.1	0.082	18.0	0.0	0.997	
Alcohol	24.0***	-1.9	0.172	14.8***	-11.7	0.006	26.6*	-0.3	0.905	26.5**	1.8	0.613	23.8***	1.1	0.792	
Water	90.0*	5.3	<0.001	86.8	2.7	0.432	92.1	6.0	0.003	88.8	6.7	0.029	90.8	4.6	0.101	
Hot beverages	86.5	-5.1	0.194	75.7*	-4.6	0.268	90.6	-4.3	0.006	94.8	-1.2	0.446	95.7	1.8	0.378	
Juice	17.4	1.6	0.143	19.6	3.1	0.420	16.4	0.3	0.909	18.0	1.8	0.540	15.8	3.8	0.259	
Sweetened beverages	30.8**	-3.5	0.097	41.8*	-9.6	0.046	29.8	-1.1	0.763	23.6	-0.1	0.958	19.9*	-2.9	0.437	*

2008/09 NZANS, 2008/09 New Zealand Adult Nutrition Survey; NNS97, National Nutrition Survey 1997.

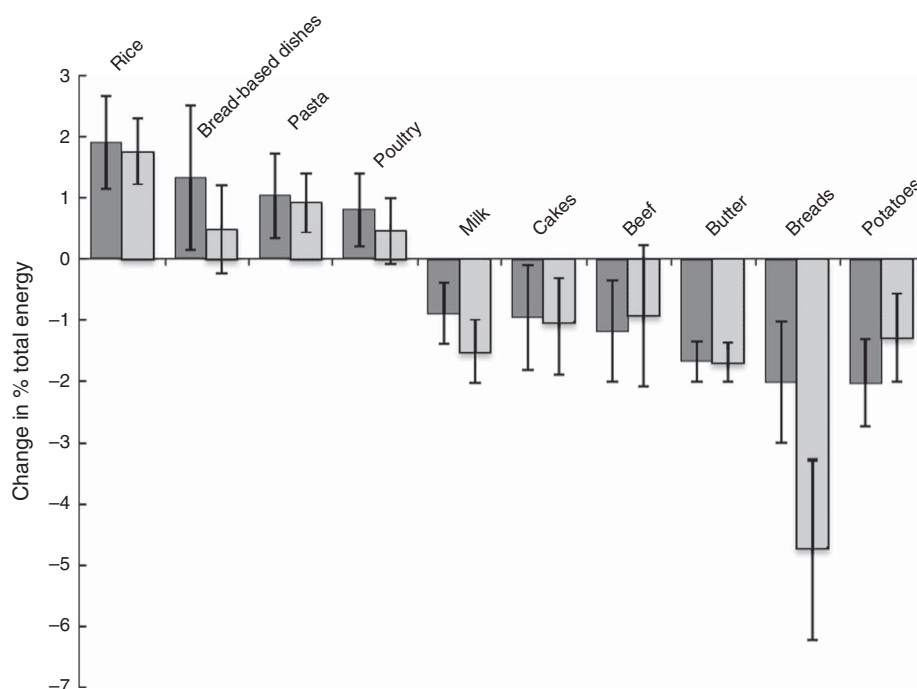
†Significant difference compared with males in 2008/09 NZANS: \**P* < 0.05, \*\**P* < 0.01, \*\*\**P* < 0.001.

‡Difference from NNS97 as percentage points.

§*P* value for comparison between NNS97 and 2008/09 NZANS; significant *P* values indicated in bold font.

¶Significant relationship between prevalence of consumption and age group for 2008/09 NZANS: \**P* < 0.05, \*\**P* < 0.01, \*\*\**P* < 0.001.

¶Fats & oils: age group × survey interaction, *P* = 0.025; poultry: age group × survey interaction, *P* = 0.024; puddings: age group × survey interaction, *P* = 0.024; sugar & confectionery: age group × survey interaction, *P* = 0.01.



**Fig. 2** Difference in mean percentage of total energy, between the 1997 National Nutrition Survey ( $n$  4339) and the 2008/09 New Zealand Adult Nutrition Survey ( $n$  3995), consumed by males (■) and females (□) aged 19 years and over, for the ten food groups with the greatest change reported. Error bars indicate 95% confidence intervals

( $-10.6\%$ ,  $P < 0.001$ ). Poultry was the only meat that increased over time, although the increase was significant only among males aged 31–50 years ( $+7.0\%$ ,  $P = 0.029$ ) and females aged 19–30 years ( $+11.4\%$ ,  $P = 0.005$ ). Among females there was evidence of a differential change in poultry consumption by age group (survey  $\times$  age group interaction:  $P = 0.024$ ). The percentage of participants who reported consuming pies nearly halved for males ( $-10.1\%$ ) and females ( $-9.8\%$ ) in all age groups (apart from females aged  $\geq 71$  years).

The percentage reporting sauces was lower in the 2008/09 NZANS compared with the NNS97 (males,  $-14.2$ ; females,  $-11.3\%$ ,  $P < 0.001$ ) and there was also a decrease among males in the percentage reporting soup ( $-4.0\%$ ,  $P = 0.013$ ).

The percentage reporting biscuits, cakes and puddings was lower in 2008/09 compared with 1997 for both males and females. For females, trends for puddings were inconsistent across age groups (survey  $\times$  age group interaction:  $P = 0.024$ ).

For all age and sex groups there was a decline in the percentage reporting the consumption of sugar and confectionery apart from females aged 19–30 years. There was a significant increase in the percentage reporting snacks and snack bars between the surveys for females ( $+4.6\%$ ,  $P = 0.007$ ). Among males the direction of change differed by age group (test for interaction:  $P = 0.032$ ), with males aged 31–50 years more likely to report snacks and snack bars in the 2008/09 NZANS ( $+3.3\%$ ,  $P < 0.001$ ) and non-significant changes in the other age groups.

Those reporting consuming alcohol declined between the 1997 and 2008/09 surveys among females aged 19–30

years ( $-11.7\%$ ,  $P = 0.006$ ) and males aged 31–50 years ( $-8.7\%$ ,  $P = 0.023$ ), but the percentage reporting water as a beverage increased for males and females ( $P < 0.001$ ).

Results from the sensitivity analysis, with the removal of low energy reporters, revealed that trends were in the same direction and of a similar magnitude to those presented in the main results (see online supplementary material, Supplementary Tables 1 and 2). However, the increase in poultry consumption was found to be greater among males with low energy reporters removed ( $+6.5\%$ ,  $P = 0.008$ ).

### **Trends in sources of energy from food groups**

Reported energy intake decreased between surveys for males in all age groups except those aged  $\geq 71$  years. Among females a significant decline was found for those aged 19–30 years ( $P = 0.019$ ; see online supplementary material, Supplementary Table 3).

The ten food groups with the greatest change in percentage contribution to daily energy are shown in Fig. 2. Supplementary Tables 4 and 5 (see online supplementary material) provide a comparison for other food groups. In summary, the percentage of daily energy from rice and rice dishes, pasta and pasta dishes, bread-based dishes and poultry increased over time and there was a reduction in the percentage of daily energy from bread, potatoes, beef, milk, butter and cakes. Among females the percentage of daily energy from bread decreased by nearly 5% (14.8% to 10.1%). All trends were in the same direction as those shown for the percentage reporting each food group.

### **Sex and age group comparisons for the 2008/09 New Zealand Adult Nutrition Survey**

Differences between males and females are highlighted in Tables 3 and 4 (by asterisks). In the 2008/09 NZANS, males compared with females were more likely to report the consumption of bread-based dishes, pies, alcohol (all  $P < 0.001$ ), sugar and confectionery, sweetened beverages (both  $P < 0.01$ ) and sausages ( $P < 0.05$ ), and were less likely to report fruit ( $P < 0.001$ ), cheese ( $P = 0.025$ ), biscuits ( $P = 0.006$ ), soup ( $P = 0.046$ ) and water ( $P = 0.036$ ). In addition, females compared with males in the youngest age group were less likely to report the consumption of beef and pork ( $P = 0.048$  and  $P = 0.049$ , respectively).

In the last column of Tables 3 and 4, significant associations between each food group and age group are highlighted (with asterisks). For both males and females there was evidence of an increase with age in the percentage reporting the consumption of bread, breakfast cereals, fruit, vegetables and potatoes. For males only there was an increase with age in the percentage reporting milk, cakes, puddings, soup and hot beverages. In contrast, there was a decrease with age in the percentage reporting the consumption of pasta and pasta dishes, rice and rice dishes, bread-based dishes, poultry, snacks and snack bars and sweetened beverages (all  $P < 0.001$ ). Among males the youngest age group was most likely to report fats and oils and least likely to report fish and seafood. The oldest age group was most likely to report consuming soup (males) and least likely to report fats and oils (females). Among males the youngest age group was less likely to report consuming butter compared with the oldest age group.

### **Discussion**

An important finding was a minimum 10% decrease in the percentage of NZ adults reporting core traditional foods of bread, potatoes, vegetables, beef and milk; in addition to a decrease in the percentage reporting butter, sugar and confectionery, pies and sauces. Bread, potatoes and beef remain major sources of energy and nutrients for the NZ diet. However, their decline and replacement with rice, pasta and poultry is evidence of an increase in dietary diversity. We found little evidence of differential changes in food group consumption by sex and age group. Despite few differences in the direction and magnitude of change by sex and age, our final analyses of the 2008/09 NZANS revealed that food group consumption was sex- and age-specific. In general, females were more likely to have a healthier profile of food selection compared with males and older adults were more likely to choose traditional foods.

### **Strengths and limitations**

A major strength of the current research was the large nationally representative sample. Another strength was the

consistent methodology for the 24 h diet recall and the food group coding.

However, no food grouping scheme is optimal; basic foods are easy to classify but mixed dishes require complex decisions and the frequency of these increased in the second survey. Not being able to specify and quantify components of mixed dishes influenced the way they were reported within a diet recall, and hence their food group allocation. For example, in the 2008/09 NZANS, more mixed dishes for which participants did not know the recipe were reported within the meat food groups (Fig. 1). Therefore in the 2008/09 NZANS, the meat food groups (such as beef) included a greater proportion of non-meat food items (such as sauces, rice, potatoes) compared with the NNS97, so they could be described as being more dilute in terms of meat content.

Another factor complicating the comparison between the two surveys is that reported energy intake was lower in the 2008/09 NZANS across all age groups in men and for women aged 19–30 years (Supplementary Table 1). The decline in energy intake observed could be a combination of an actual decline and an increase in under-reporting. All dietary assessment methods are associated with some level of under-reporting. However, an increase in under-reporting over time could have implications for our findings. Secular changes have been documented with respect to increased under-reporting<sup>(12)</sup>, thought in part to be due to increased health consciousness and social desirability<sup>(13)</sup> and an increased prevalence of overweight and obesity<sup>(4,9,14)</sup>. There is also evidence for selective under-reporting of some foods considered less socially desirable, such as cakes and pastries, sugar and confectionery, and hot chips/French fries<sup>(15)</sup>. In order to take into account the decline in energy intake between the surveys, we also examined trends using percentage of total energy from each food group and conducted a sensitivity analysis with low energy reporters removed. For both analyses the results were consistent and in the same direction as our main analyses (Supplementary Tables 3 and 4). We are therefore confident that the trends we found are robust and reflect what has actually occurred within the NZ population.

### **Trends in food group consumption**

The decline in the consumption of the staple carbohydrate foods, such as bread and potatoes, is congruent with a higher consumption of rice and pasta. Potato consumption has similarly been shown to have declined among adults in the UK<sup>(16,17)</sup>, France<sup>(18)</sup>, Spain<sup>(19)</sup> and Sweden<sup>(20)</sup>. Suggested reasons for the displacement of potatoes in the UK include: (i) the longer time required to prepare and cook potatoes compared with pasta and rice; (ii) an increase in ethnic cuisine; and (iii) increased availability of rice and pasta<sup>(21)</sup>. These reasons are probably also applicable to NZ.



The large decrease we have shown in bread consumption should be closely monitored, in particular among young females. Our findings showed the compensatory increase in percentage of daily energy from bread-based dishes in males but not in females. Given the need to augment iodine intake and considering the reduced use of discretionary iodized salt, it is now mandatory to fortify bread with iodized salt in NZ and Australia<sup>(22)</sup>. The effectiveness of this programme in NZ may be compromised if bread intake reduces. In addition, bread is a vehicle for folic acid – although unlike iodine, it is not mandatory that bread in NZ be fortified with folic acid<sup>(23)</sup>. Similar downward trends in bread consumption have occurred in the UK and the decline has been attributed to an increased perception of bread as ‘fattening’, the fad to reduce carbohydrate intake, avoidance due to perceived wheat or gluten intolerance or allergies, and increases in the relative price of bread<sup>(24)</sup>. In NZ, those of South Asian, East Asian and South-East Asian ethnicities are less likely than NZ Europeans to report consuming bread<sup>(25)</sup>. The proportion of these ethnicities is increasing in NZ. Between 1996 and 2006 the ‘Asian’ population approximately doubled to 9.2% of the population (from 194 800 to 404 400)<sup>(26)</sup>. Bread is still a major source of energy and nutrients in NZ, but the potential nutritional impact of ongoing declines in consumption should be monitored.

Despite an ongoing ‘5+A Day’ campaign in NZ, fruit intake has not changed since 1997. In contrast, fruit intake in the UK and France has increased<sup>(16,18)</sup>. Furthermore, our findings indicate a decrease in the percentage reporting the food group vegetables, although this may be partly offset by a greater intake of vegetables from mixed dishes. Work is currently in progress to disaggregate mixed dishes to provide a complete estimate of vegetable intake as has been conducted in the UK<sup>(27)</sup> and the USA<sup>(28)</sup>.

Between 1995 and 2002, the per capita red meat supply in NZ decreased by 36%<sup>(29)</sup>. Descriptive results reported elsewhere showed Fe and Zn intakes declined for males between the NNS97 and 2008/09 ANS, and Zn intake declined among females<sup>(4)</sup>. A reduction in beef and lamb consumption has also been shown in other countries, including the USA<sup>(30)</sup> and in Australia along with an increase in poultry<sup>(31)</sup>. Our results revealed beef consumption decreased most among women aged 19–30 years, the age group most in need of haem Fe. However, a large increase in poultry consumption may to some extent have countered this effect. Young females may perceive chicken as light and fresh (‘feminine’ food), healthy (low in fat), versatile due to its blandness and convenient (portions that are easy to cook and prepare)<sup>(32)</sup>. As in the UK<sup>(16)</sup>, poultry is now the most commonly eaten meat in NZ.

Our results show a reduction in reported butter consumption with concurrent small increases in fats and oils, and margarine. However, care should be taken in interpreting these results. The food group fats and oils included known ingredients in mixed dishes entered as a recipe. It also captures fats and oils possibly added before

consumption, such as olive oil as a dip for bread. Similarly, butter and margarine consumption reflects known ingredients in mixed recipes (including sandwiches) and that added to food as a spread, but not baked goods and bread-based dishes (for which participants did not report recipes), and therefore we do not have a complete picture of consumption of various fats and oils. The percentage of daily energy from table spreads and margarine declined over the study period, possibly reflecting the greater availability of reduced-fat table spreads and the decline in bread consumption.

In 2008, food prices in NZ rose by 8% from the previous year, the largest annual increase in food prices since 1990. There were substantial increases between 2001 and 2008 in the price of butter (89%) and milk and cheese (22%)<sup>(33)</sup>. Prices for these foods have continued to rise and this may have had a lasting impact on food choices<sup>(34)</sup>. It is interesting that although the percentage reporting milk declined, Ca intake was similar between the surveys for females and increased for males<sup>(4)</sup>. This may be because of increased fortification of dairy products, including Ca-enriched milk which was not available in 1997.

We found a decline in the percentage reporting some ‘eat less’ foods (sugar and confectionery, cakes, biscuits and puddings). This change may explain the significant decrease in sucrose intake reported for males between the two surveys<sup>(4)</sup>. There was a small increase in those reporting snack foods such as crisps and cereal bars. Within an Australian context, Branwell *et al.* argue that the disappearance of puddings and desserts is indicative of wider changes with respect to family eating habits which are driven by greater time pressures and increased availability of more convenient treats that can be eaten at any time of day<sup>(35)</sup>.

Meat pies are considered an iconic national dish in NZ<sup>(36)</sup>. However, the combination of the pastry and poor-quality meat means they are often high in fat. Although still a popular takeaway food<sup>(37)</sup>, their popularity is clearly waning.

### **Sex and age differences**

The current analysis shows that there are differences in reported food choice between males and females across all age groups. This is congruent with other research which has shown a greater intake of foods such as fruit and vegetables among females<sup>(38–40)</sup>. Females have been described as having a more ‘virtuous’ approach to food compared with males<sup>(39)</sup>. They are more likely to report to adhering to dietary guidelines and more inclined to consider moral and ethical issues surrounding food choice<sup>(39)</sup>.

The greater contribution of meat to the diet of males compared with females has been shown in Europe<sup>(41,42)</sup> and the USA<sup>(30)</sup>. In the 2003–04 National Health and Nutrition Examination Survey males compared with females reported a higher intake of red meat but a lower intake of poultry<sup>(30)</sup>. Research in the UK found more females reported they had

decreased red meat intake in the past 10 years or had avoided red meat compared with males<sup>(39)</sup>. In our study we did not find evidence of a difference between males and females in the percentage who reported consuming beef, lamb or poultry or in the percentage of daily energy they contribute. We found, however, that males compared with females were more likely to report pies (mostly meat pies) and sausages and processed meats, all of which are higher in fat than leaner cuts of meat.

Nutrition education is frequently aimed at females as the gatekeepers of family health. Nevertheless, males carry a greater burden in terms of diet-related chronic disease. In 2006 CHD accounted for nearly double the number of deaths (12%) in males compared with females (7%) in NZ<sup>(43)</sup>. Males are increasingly sharing the food preparation for a household<sup>(44)</sup> and may be a more important influence, and thus targets for future interventions. Health promotion campaigns targeting males should focus on decreasing consumption of processed meats, alcohol and sweetened beverages and on increasing both fruit and vegetable intakes.

Trends were in the same direction and of a similar magnitude by age group for nearly all food groups. This suggests that changes to the food supply and environment have impacted on different age groups equally. However, clear differences were found in food choices by age in the 2008/09 NZANS. Older adults were more likely to report fruit, vegetables, bread and potatoes compared with younger adults. They were also more likely to report cakes, puddings and biscuits compared with younger age groups, but were less likely to choose snacks, snack bars and sweetened beverages. Our results suggest older adults were more likely to follow a traditional NZ diet pattern with lower intakes of pasta and rice. To support this view, in previous research we found that young NZ adults were more likely to consume fast food compared with older adults<sup>(37)</sup>.

Devine argues that a life-course approach should be taken to understand food preferences<sup>(45)</sup>. Earlier food preferences are maintained as we age and 'past food experiences set the stage for current food choices'<sup>(45)</sup>. People born at different times have been exposed to different environments, nutritional information and dietary guidelines<sup>(45)</sup>. Some dietary changes occur in response to life events, such as pregnancy, but many dietary patterns are taken forward as we age. The dietary choices of the younger age groups do give some indication of future habits.

## Conclusions

Food is inextricably linked to culture and changes to dietary patterns can be slow. However, in the past 50 years, with changes in agriculture we have seen the fastest change in food supply in human history. The present paper gives an overview of trends in adults' food group consumption between two NZ national surveys over a

12-year period. We have found a reduction in the consumption of beef, potatoes and bread, all traditional pillars of a NZ diet; in contrast, there has been an increased consumption of rice and pasta. Greater inclusion of mixed dishes (such as stir-fries) provides challenges to the way we assess food intake and estimate amounts consumed in the future.

Further, in-depth analyses at the sub-food group level with consideration of the impact on nutrient intakes resulting from some of the key trends would be useful. A decrease in the percentage reporting pies, sugar and confectionery, biscuits, cakes, puddings and butter can be seen as change in a more healthful direction and in congruence with dietary guidelines. Our findings, however, do not demonstrate an improvement in fruit consumption and also show increases in the percentage reporting snacks and snack bars.

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## Supplementary material

To view supplementary material for this article, please visit <http://dx.doi.org/10.1017/S1368980015000890>

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