

Food and nutrient availability in New Zealand: an analysis of supermarket sales data

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Submitted 1 August 2006: Accepted 15 February 2007: First published online 3 July 2007

Abstract

Objective: To examine food and nutrient availability in New Zealand using supermarket sales data in conjunction with a brand-specific supermarket food composition database (SFD).

Design: The SFD was developed by selecting the top-selling supermarket food products and linking them to food composition data from a variety of sources, before merging with individualised sales data. Supermarket food and nutrient data were then compared with data from national nutrition and household budget/economic surveys.

Setting: A supermarket in Wellington, New Zealand.

Subjects: Eight hundred and eighty-two customers (73% female; mean age 38 years) who shopped regularly at the participating supermarket store and for whom electronic sales data were available for the period February 2004–January 2005.

Results: Top-selling supermarket food products included full-fat milk, white bread, sugary soft drinks and butter. Key food sources of macronutrients were similar between the supermarket sales database and national nutrition surveys. For example, bread was the major source of energy and contributed 12–13% of energy in all three data sources. Proportional expenditure on fruit, vegetables, meat, poultry, fish, farm products and oils, and cereal products recorded in the Household Economic Survey and supermarket sales data were within 2% of each other.

Conclusions: Electronic supermarket sales data can be used to evaluate a number of important aspects of food and nutrient availability. Many of our findings were broadly comparable with national nutrition and food expenditure survey data, and supermarket sales have the advantage of being an objective, convenient, up-to-date and cost-effective measure of household food purchases.

Keywords
New Zealand
Nutrition surveys
Nutritive value
Supermarket sales
Food expenditure

Along with tobacco use and physical inactivity, diet-related risk factors (high blood pressure, high cholesterol, high body mass index and low fruit and vegetable consumption) are responsible for most of the global burden of chronic non-communicable disease¹. In New Zealand, an estimated 40% (11 000) of all deaths annually are due to these four modifiable nutrition-related risk factors². Over half of all New Zealand adults are either overweight or obese³ and the costs to society in terms of health and health-care costs are significant⁴.

Reducing diet-related disease is a priority for public health action worldwide and improving nutrition is one of three objectives of New Zealand's national nutrition strategy, Healthy Eating – Healthy Action⁵. Measuring food consumption is necessary in order to monitor pro-

gress towards this goal, as well as to understand diet-disease relationships, identify dietary trends, evaluate interventions, set priorities for action and inform policy.

Current sources of national dietary data in New Zealand are food balance sheets (food supply), household economic surveys (food expenditure), total diet surveys (food safety) and 10-yearly national nutrition surveys (food consumption). National nutrition surveys are essential for measuring population dietary intake and nutritional status but they are costly and labour-intensive. Results can take some time to be published and the self-report dietary assessment methods used are prone to inaccuracies and biases. Alternative sources of timely and up-to-date dietary data could therefore supplement existing surveys.

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The advent of computerised food sales data has meant that this approach is being increasingly used in nutrition research and may also provide a useful source of national dietary data. Supermarket sales data have been used for a variety of purposes, including testing interventions that promote healthier food choices⁶⁻⁹, understanding determinants of food purchasing behaviour^{10,11}, measuring regional differences in dietary habits^{12,13} and as an index of nutrient intake in a population who buy most of their food from supermarkets¹⁴.

Our aim in the present study was to examine food and nutrient availability in New Zealand using individualised supermarket sales data from a major supermarket store, and to compare our findings with national surveys of food consumption and expenditure.

Methods

These analyses used supermarket sales data collected during the SHOP (Supermarket Healthy Options Project) pilot study, which assessed the feasibility of a randomised controlled trial of strategies to promote healthier food purchases in supermarkets. The methodology and main findings of the SHOP pilot study have been reported in full elsewhere¹⁵.

Electronic shopping data were collected using a system available in some supermarket stores in New Zealand in which registered customers use a hand-held barcode scanner to keep a record of items scanned in or out of their trolley. For these analyses, sales data from a single store were used for those customers who were eligible to take part in the SHOP pilot study* and who had data available for the 12-month period from February 2004 to January 2005.

The top-selling 3000 food and non-alcoholic products purchased by the eligible customers over one year were selected for the supermarket food composition database (SFD) using the following process. Fixed-weight products purchased by unit (e.g. canned foods, soft drinks) were ranked by the total number of units purchased, and variable-weight items (e.g. fruit, vegetables, self-select foods) were ranked by the total number of kilograms purchased. Products with the highest sales volume of each type were selected in the same proportions that each type contributed to the entire product list.

The following food composition data were obtained for each product: energy (kJ), protein (g), total fat (g), saturated fat (g), carbohydrate (g), total sugars (g) and sodium (mg) per 100 g or 100 ml. Where possible, product- and brand-specific nutrient composition data were sourced from the Manufactured Food Database (MFD)¹⁶,

brand websites, manufacturers or from the product's nutrition information panel, which is mandatory on all packaged New Zealand foods. The MFD is a database of food composition data for many brands sold in New Zealand and the main users are nutritionists, dietitians and the public, who use it to search for allergen-free products¹⁶.

Food composition data for generic and unbranded products such as fruit, vegetables, meat packed by the supermarket butchery, bread and baked goods from the supermarket bakery, and deli products were sourced from the New Zealand Food Composition Database (NZFCD)¹⁷.

Average nutrient quantities per 100 g/100 ml were multiplied by the weight or volume of the product to calculate the total nutrients available in each product unit. Where the product description supplied by the supermarket contained no information about the product's weight, such as single-item vegetables, the items were weighed by one author (S.H.) at the supermarket.

Products for which food composition data could not be obtained and those that contained little or no energy such as teabags and bottled water were not included in the database. For each product removed from the database, the next highest-ranked product was added to bring the total number to 3000.

Data analysis

To assess the completeness of the SFD in terms of total food purchases made by the study population, expenditure on the top-selling 3000 products was calculated as a proportion of total expenditure on all products for all shoppers. The same process was used to calculate the proportion of total sales volume (units) made up by the top-selling products. The most commonly purchased foods overall and within certain food groups were identified.

Major food sources of macronutrients were compared with the findings of two national nutrition surveys. The Children's Nutrition Survey (CNS) assesses the diet of children aged 5-14 years and the National Nutrition Survey (NNS) samples adults aged 15 years and older^{18,19}. Macronutrient contributions to energy in the supermarket sales database were compared with the 1997 NNS and the 2002 CNS. It was not possible to estimate absolute nutrient intakes using supermarket sales data because data on number, age and sex of individual household members were not available. Therefore only relative nutritional variables, such as proportional contributions of macronutrients to energy, were calculated.

Next, the major dietary sources of nutrients were compared between the supermarket sales database and both nutrition surveys. Each supermarket product was categorised into the same food groups used in the NNS and these were validated by an independent coder.

*Aged 18 years or older, and shopped regularly at the participating supermarket store (i.e. shopped twice a month and spent no less than \$NZ 200 per month on average).

Since the NNS includes alcohol intake and supermarket sales of alcohol were not included in this research, both the nutrient contributions to energy and dietary sources of nutrients in the NNS were recalculated after removing alcohol in order to make the data sources more comparable.

The Household Economic Survey (HES) measures the incomes and expenditure patterns (including food expenditure) of private households in a nationally representative sample triennially²⁰. Food expenditure was compared between supermarket sales data and the 2003/04 HES. The top-selling 3000 products in the supermarket sales database were coded using the HES food groups by the main author and validated by a second researcher. The HES measures all household food expenditure and includes the major categories 'ready-to-eat foods' (take-aways, bakery foods) and 'meals away from home' (restaurant and café meals). Since these food groups largely do not include supermarket items they were excluded to make the data sources more comparable. The 'ready-to-eat foods' category included some items that may be purchased at a supermarket such as sandwiches or hot pies; however, since these were only a very small proportion of sales, they were also excluded. Average weekly household expenditure in each food group was therefore calculated as a percentage of average total expenditure, less expenditure on 'ready-to-eat foods' and 'meals away from home'. These categories contributed a total of 25% to expenditure in the HES.

All analyses were conducted using Stata statistical software, version 8.

Results

Eight hundred and eighty-two customers contributed data to these analyses. The average age of the sample was 38 years, and 73% were female.

The SFD included the 3000 highest-selling products in terms of sales volume, of which 90% (2700) were sold by unit weight and 10% (300) were sold by variable weight. These 3000 products represented 30% of the all the products purchased by shoppers over a 12-month period, yet contributed to more than 80% of total expenditure and sales volume.

Top-selling products

Tables 1 and 2 list the top-selling food products overall, and within major food groups that were purchased by this sample of supermarket shoppers. Top-selling supermarket products in New Zealand included full-fat milk, powdered cordials, cola drinks, white bread and butter.

Within their respective food categories, the most popular types of foods purchased were full-fat milk (milk), butter (fats and oils), white bread (bread), full-sugar soft

Table 1 Top-selling supermarket products

Products purchased by fixed unit	Products purchased by variable weight
Brand P homogenised milk	Bananas
Eggs	Apples
Brand V powdered cordial (all flavours)	Beef mince
Brand C cola drink	Tomatoes
Broccoli	Carrots
Brand T white bread	Chicken breasts
Brand N white bread	Oranges
Lettuce	Kiwifruit
Brand R powdered cordial (all flavours)	Pears
Potatoes	Mandarins
Brand D butter	Chicken drumsticks/legs
Brand B white bread	Lamb roasts
Brand C diet cola drink	Grapes
Brand P Calci-Smart milk	Ham (all varieties from delicatessen counter)
Onions	Pumpkin

Table 2 Top-selling supermarket products by food group

Food group (ranked by)	Top-selling products
Meat, poultry, seafood (kg)	Whole chicken, Beef mince, Beef steak (all cuts), Sausages (all), Chicken breast
Breads (units)	Brand T white, Brand N white, Brand B white, Brand V mixed grain, Brand P white
Breakfast cereals (units)	Brand S weetbix, Brand S cornflakes, Brand S ricies, Brand K nutrigrain, Brand B cocoa puffs
Fats and oils (units)	Brand D butter, Brand A butter, Brand S no-cholesterol margarine, Brand M spread, Brand C butter
Milk (litres)	Brand P homogenised, Brand P Calci-Smart, Brand M Calci-Trim, Brand P Slim (reduced-fat), Brand M homogenised
Fresh vegetables (kg)	Potatoes, Carrots, Onions, Tomatoes, Lettuce
Fresh fruit (kg)	Bananas, Apples, Oranges, Mandarins, Kiwifruit
Grains and pasta (units)	Brand W spaghetti (canned), Brand S spaghetti (dry pasta), Brand S penne rigati (dry pasta), Brand M 2-minute chicken noodles, Brand F 2-minute chicken noodles
Non-alcoholic beverages (units)	Brand V powdered cordial (all flavours), Brand C cola, Brand R powdered cordial (all flavours), Brand C diet cola, Brand C lemonade

drinks (non-alcoholic beverages) and biscuits (high-energy snack foods) (Fig. 1).

Macronutrient contributions to energy

The contributions of total fat, saturated fat and carbohydrate to energy in supermarket foods were broadly similar to those reported in the NNS and CNS (Fig. 2). The greatest difference seen was in the proportion of energy derived from carbohydrate. This was similar in the supermarket sales database and NNS (49% and 48%,

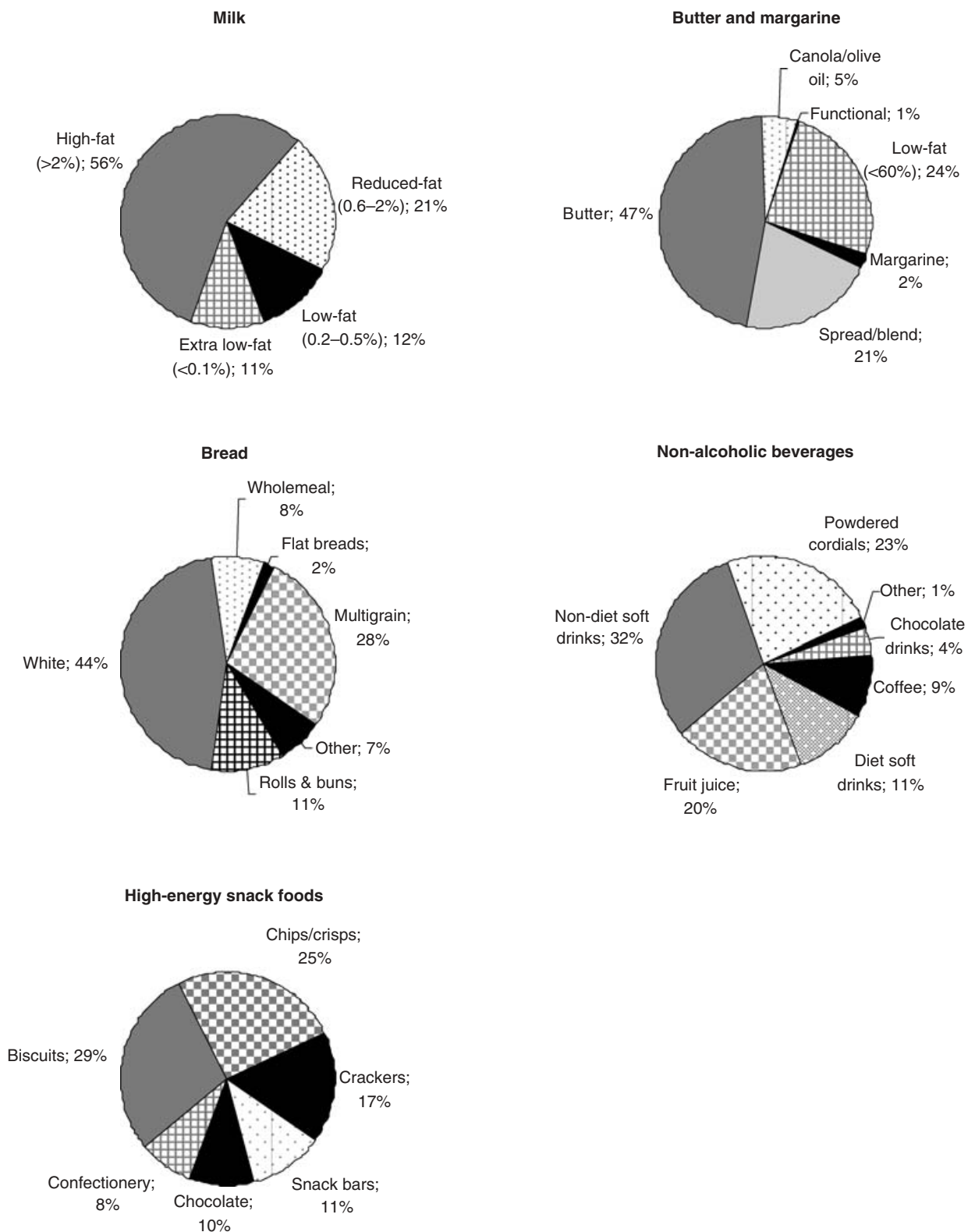


Fig. 1 Proportional contributions of major food types to total sales within key food groups

respectively) but significantly higher in the CNS (54%). The proportion of energy from protein was 3% lower in the sales database than in the NNS, although compared with the CNS it was the same (14%). The contribution of

saturated fat was similar across all three data sources. However, total fat made up a greater proportion of energy in the sales database than in the CNS (37% and 33%, respectively).

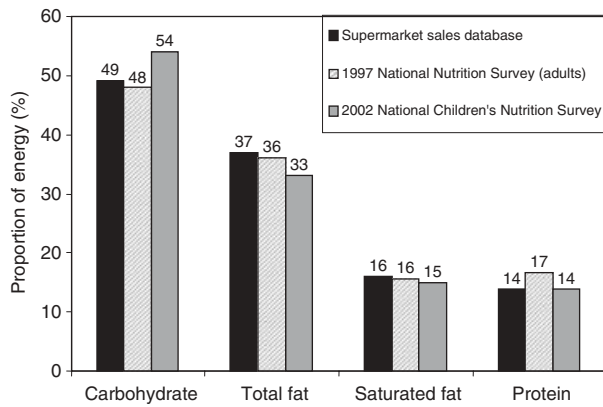


Fig. 2 Proportion of energy from macronutrients (%)

Major food sources of nutrients

Bread was the major source of energy, contributing 12–13% in all three data sources (Table 3). Most other major sources of energy in supermarket products contributed a similar proportion to that in either one or both of the nutrition surveys.

Food expenditure

Figure 3 shows supermarket expenditure on all major food categories compared with household expenditure reported in the HES. The proportion of expenditure was similar for all categories except 'sweet products, spreads and beverages' and 'other foodstuffs', which was substantially higher in the HES than supermarket sales data. The difference between the two data sources for the food category 'sweet products, spreads and beverages' was explained by much lower supermarket expenditure on 'confectionery' and 'beverages' (data not shown). The difference in the category 'other foodstuffs' was largely due to the food group 'groceries not elsewhere classified' for which there were no equivalent supermarket products. This HES food item code was for miscellaneous bulk food purchases that were recorded by respondents without any detail about the type of food purchased.

Discussion

Our analyses demonstrate primarily that that some of the most popular supermarket products sold in New Zealand are also the less healthy ones. Full-fat milk, white bread, full-sugar soft drinks, butter and sweet biscuits were the most popular choices within their respective food groups. The high sales of these products are contrary to national nutrition guidelines, which recommend eating less fatty, salty and sugary foods, eating wholegrain breads and choosing low-fat milk and milk products²¹. Sugary drinks in particular have been under the spotlight recently for their contribution to the increasing rates of obesity^{22–25}. The findings from our supermarket sales data support this

concern, especially given that soft drinks featured six times in the top 30 products, and two sizes of cola drinks were among the top 10 alone.

Many key dietary sources of energy, fat, protein and carbohydrate were similar in both the national nutrition surveys and supermarket sales data despite differing methodologies. The main difference was the high contribution of potatoes and kumara to both energy and fat in the NNS compared with the supermarket data. However, the NNS collected data on food intake from all sources and this food group included prepared, fried potato and kumara which have a high fat content and are not usually purchased from supermarkets.

The HES collected data on household foods purchased from any location including takeaways, restaurant meals, bakery items and school lunches, and like supermarket sales data, it measured purchased foods rather than food consumption. Twenty-five per cent of food expenditure was spent on the food groups 'meals away from home' and 'ready-to-eat' meals, which, in the main, are not supermarket foods. Aside from this, the major difference between sales data and the HES was a significantly greater amount of expenditure in the HES on 'confectionery' and 'beverages'. This is probably due to the availability of these foods from many outlets other than supermarkets. For foods that are most likely to be purchased solely from a supermarket, including biscuits, breakfast cereals, frozen vegetables, canned fruit and vegetable oils, proportional expenditure was very similar in both data sources.

The reasons for discrepancies between these data sources are likely to be due to different sample populations, underreporting in the HES and the nutrition surveys, or, alternatively, they may be indicative of foods that are purchased and/or consumed in the diet overall but are not bought from the supermarket.

Using supermarket sales to assess diet has a number of limitations. First, food that is purchased from the supermarket does not necessarily reflect the total household diet. Food that is either purchased from other outlets or brought into the house by others is not accounted for. There is a growing trend towards buying food away from home, and in New Zealand a quarter of the food budget is spent on restaurant or café meals and takeaway foods²⁰. Since many of these products are high-fat, 'fast foods', they make a significant impact on the nutritional adequacy of the diet, which is not accounted for if supermarket sales data alone are used to assess food purchases.

Second, supermarket sales data provide information on foods that are brought into the home for consumption by household members. They do not provide individual-level information about which members are eating what foods and how much. In some studies, sales data have been used to estimate individual nutrient intakes. However, this requires additional information about the age and gender of household members, wastage, and foods that are eaten away from the home or by visitors.

Table 3 Major dietary sources of nutrients: comparison of supermarket sales data with national nutrition survey data

Nutrient	Food source (% contribution to total nutrient)		
	Supermarket Foods Database (2004)	Adult National Nutrition Survey (1997)	Children's National Nutrition Survey (2002)
Energy	Bread (12%) Grains & pasta (8%) Butter & margarine (7%) Sugar/sweets (7%) Fruits (6%) Biscuits (6%) Milk (5%) Potatoes & kumara (5%) Non-alcoholic beverages (5%) Poultry (4%) Beef & veal (4%)	Bread (12%) Potatoes & kumara (7%) Butter & margarine (6%) Milk (5%) Alcoholic beverages (5%) Cakes & muffins (5%) Non-alcoholic beverages (5%) Sugar/sweets (5%) Beef & veal (4%) Fruits (4%)	Bread (13%) Potatoes, kumara & taro (8%) Biscuits (6%) Beverages (6%) Milk (6%) Fruits (5%) Sugar/sweets (5%) Grains & pasta (5%) Cakes & muffins (4%) Dairy products (4%)
Total fat	Butter & margarine (20%) Fats & oils (9%) Cheese (7%) Beef & veal (7%) Poultry (7%) Biscuits (5%) Milk (5%) Dairy products (4%) Pork (4%) Sausage & processed meats (4%)	Butter & margarine (16%) Potatoes & kumara (6%) Beef & veal (6%) Milk (6%) Cakes & muffins (6%) Pies & pasties (5%) Bread based dishes (5%) Sausages & processed meats (5%) Fats & oils (4%) Cheese (4%)	Potatoes, kumara & taro (9%) Milk (8%) Biscuits (7%) Butter & margarine (6%) Pies & pasties (6%) Poultry (6%) Sausages & processed meats (5%) Cakes & muffins (5%) Dairy products (5%) Beef & veal (5%)
Saturated fat	Butter & margarine (21%) Cheese (11%) Milk (8%) Dairy products (7%) Biscuits (7%) Beef & veal (7%) Poultry (5%)	<i>Not reported in NNS</i>	Milk (11%) Potatoes, kumara & taro (9%) Biscuits (9%) Pies & pasties (7%) Dairy products (6%) Cheese (6%) Cakes & muffins (5%) Sausages & processed meats (5%) Butter & margarine (5%) Beef & veal (4%)
Carbohydrate	Bread (18%) Sugar/sweets (13%) Grains & pasta (12%) Fruits (11%) Non-alcoholic beverages (10%) Biscuits (7%) Potatoes & kumara (7%) Breakfast cereal (5%)	Bread (20%) Non-alcoholic beverages (10%) Potatoes & kumara (10%) Sugar/sweets (9%) Fruits (8%) Cakes & muffins (6%) Breakfast cereals (5%) Grains & pasta (5%)	Bread (20%) Beverages (11%) Potatoes, kumara & taro (9%) Fruits (8%) Sugar/sweets (7%) Biscuits (7%) Breakfast cereals (6%) Grains & pasta (5%) Cakes & muffins (4%) Milk (4%)
Sugar	Sugar/sweets (26%) Fruits (20%) Non-alcoholic beverages (19%) Milk (8%) Biscuits (6%) Dairy products (6%) Vegetables (5%) Sauces (3%) Breakfast cereal (2%)	<i>Not reported in NNS</i>	Beverages (26%) Sugar/sweets (21%) Biscuits (11%) Fruits (11%) Dairy products (9%) Cakes & muffins (7%) Puddings & desserts (2%) Breakfast cereals (2%) Nuts & seeds (2%) Milk (2%)
Protein	Bread (12%) Poultry (12%) Beef & veal (11%) Milk (10%) Cheese (7%) Grains & pasta (6%) Pork (6%)	Beef & veal (14%) Bread (11%) Milk (10%) Poultry (7%) Fish/seafood (7%) Bread-based dishes (5%) Pork (5%)	Bread (13%) Milk (11%) Poultry (9%) Beef & veal (8%) Bread-based dishes (5%) Grains & pasta (5%) Potatoes, kumara & taro (4%) Sausages & processed meats (4%) Fish/seafood (4%) Breakfast cereals (4%)
Sodium	Breads (17%) Sauces (8%) Pork (6%) Sausages & processed meats (6%) Grains & pasta (6%) Cheese (5%)	<i>Not reported in NNS</i>	<i>Not reported in CNS</i>

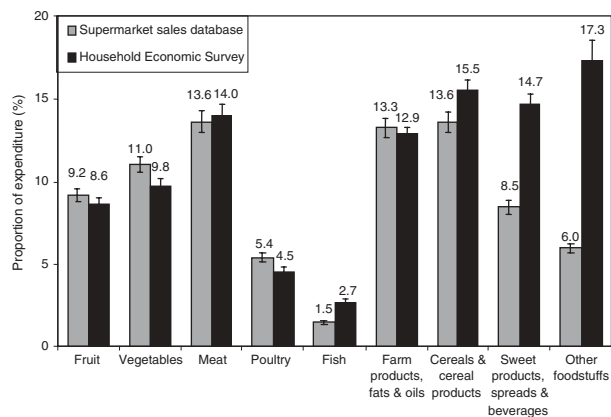


Fig. 3 Expenditure on major food categories

Third, the nutrient content of supermarket foods only relates to foods in their 'purchased' or raw state rather than when they are consumed. It does not reflect preparation practices or cooking methods and nor does it take into account additional ingredients that are added or foods that are combined or wasted.

Finally, most food composition data listed on nutrition labels are estimated from generic data, such as in the NZFCD, as well as international databases, rather than being based on analyses of the food itself. Therefore the accuracy of this information is uncertain.

With respect to the SFD that was developed for this study, its major limitation is a potential lack of generalisability to the New Zealand population. Customers whose sales data were used for these analyses were recruited from only one supermarket store in one city in New Zealand, and they were recruited from a database of users of a self-shopping system (Shop 'N Go). They may, therefore, be more educated and more adept with technology than non-users and have different purchasing habits. In addition, product brands are not sold consistently across different supermarkets or even throughout all stores of one supermarket, so the top-selling products in our SFD may not reflect those of other supermarkets. Comparison of our results with sales data from other supermarkets would be useful to assess their generalisability, although such commercial sales data are not readily available and are usually expensive to purchase.

Despite these limitations, electronic supermarket sales data have several strengths.

Food purchasing is an upstream behaviour to food consumption and therefore sales data are a valid source of information about household food and nutrient availability. In New Zealand, most of the household food budget is spent at the supermarket²⁶, so supermarket foods are the largest single contributor to the diet of most people.

Individualised, electronic sales data have a number of advantages over traditional methods of collecting dietary data. They are not intrusive and can be collected without

any effort or time on the part of the respondent. They are not prone to recall bias, observer bias or reporting bias, as with many self-report dietary assessment methods. Furthermore, data can be collected over long periods of time and are available immediately.

Electronic supermarket sales and food composition data can be used to assess many aspects of diet such as major food sources of nutrients and trends in frequently purchased foods. This approach is not a substitute for traditional dietary assessment methods that allow the calculation of absolute nutrient intakes of individuals. However, it does offer a unique opportunity to objectively and cost-effectively assess trends in food purchasing and the quality of foods and nutrients brought into the home.

The use of supermarket sales data in experimental settings, such as for evaluating nutrition interventions, has been documented^{16,9,27}, but they also have potential as a source of national dietary data for monitoring nutrition. Sales data could be used to supplement other sources of national dietary information, in order to monitor trends in household nutrient availability between national health and nutrition surveys.

The question of whether supermarket sales data are a feasible source of information for population nutrition monitoring, however, warrants further research. It would be necessary to identify existing sources of nationally representative sales data and to investigate the availability of these for nutrition surveillance. For example, sales data collected for market research purposes, such as AC Nielsen's Homescan²⁸, provide a large amount of data for a nationally representative sample. Supermarket loyalty schemes are another source of sales data, although privacy laws limit the amount of personal and household information that can be collected and made available by supermarkets. The availability of non-sales information such as household income, ethnicity and household composition (number, age and gender of household members) would allow supermarket sales data to be used for investigating associations between these demographic factors and food purchasing patterns.

Conclusions

Alternative sources of dietary data are needed to supplement current methods of assessing diet. New Zealand's national nutrition surveys are conducted once every 10 years, alternating 5-yearly between child and adult surveys, and it is important that dietary trends are monitored in the interim. In addition, many traditional methods of dietary assessment have a number of limitations; namely, high respondent burden, researcher burden and susceptibility to reporting and recall bias.

Supermarket sales are an objective, cost-efficient and convenient source of dietary data with few of the limitations associated with individual dietary assessment

methods. They offer many potential applications, including monitoring population food and nutrition purchases, assessing the nutritional quality of household food, and evaluating the direct impact of population-based initiatives and policies on food purchasing habits.

Acknowledgements

Sources of funding: The SHOP pilot study was primarily funded by the Health Research Council of New Zealand (HRC Grant 04/200) and the National Heart Foundation of New Zealand (Grant No. 1113). The Cancer Society of New Zealand also provided some financial support.

Conflict of interest declaration: None declared.

Authorship responsibilities: S.H. was responsible for the design and conduct of this research, data analysis and the drafting of this paper. C.N.M. and P.P. were responsible for advising on research design and analysis and providing input into the revision of this paper. C.N.M. was the Principal Investigator of the SHOP Pilot Study during which sales data used in this research were collected.

Acknowledgements: We are grateful to the following people who provided technical and statistical advice: Alex Bormans, Yannan Jiang, Alistair Stewart and Roger Marshall. The electronic sales data used in these analyses were provided by Foodstuffs (Wellington) Co-Operative Society Ltd.

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