

Dietary Intakes of Pacific Ethnic Groups and European People.

Metcalf P A^{1,2}, Scragg R R K¹, Sundborn G¹, Jackson R¹

ABSTRACT

Objective To compare dietary intakes, food servings, and cooking practices of Pacific ethnic groups with New Zealand Europeans.

Methods Daily nutrient intakes were calculated from a self-administered food frequency questionnaire from a cross-sectional health screening study. Participants were Pacific (n=954) and New Zealand European (n=1,745) people aged 35 to 74 years.

Results Total energy intakes in Samoan and Niuean men were higher than European men, while for women, total energy intakes were significantly higher in all Pacific ethnic groups compared to New Zealand European women. Pacific men and women had lower alcohol and calcium intakes compared to New Zealand Europeans, and Pacific men had higher protein and cholesterol intakes. Pacific adults reported eating more servings of fish, chicken and bread, fewer servings of cheese and breakfast cereal per month, and boiled their meat more often than European adults.

Conclusions Substantial differences in dietary habits and cooking practices exist between European and the different Pacific adult groups mainly related to the frequency of consumption of certain food/nutrient groups and greater serving sizes in Pacific compared to New Zealand European adults. Implications Strategies targeting serving sizes and frequency of consumption of specific food groups may help address the major ethnic disparities in nutrition-related health problems in New Zealand.

Key words: Diet survey, nutrients, ethnicity, adults

AUTHOR AFFILIATIONS:

¹Division of Epidemiology and Biostatistics, School of Population Health, University of Auckland, Private Bag 92019, Auckland.

²Department of Statistics, University of Auckland.

CORRESPONDENCE:

Dr Patricia Metcalf, Division of Epidemiology and Biostatistics, School of Population Health, Tamaki Campus, University of Auckland, Private Bag 92019, Auckland. e-mail p.metcalf@auckland.ac.nz Ph 64-9-3737-599 Ext 87715 Fax 64-9-3737-000.
R. Scragg email r.scragg@auckland.ac.nz
G. Sundborn email g.sundborn@auckland.ac.nz
R. Jackson email rt.jackson@auckland.ac.nz

Introduction

Nutrition-related risk factors play a role in the development of heart disease, diabetes, stroke, cancer and other major health problems.¹ In 1997, an estimated 8500 deaths in New Zealand were due to the combined effects of poor diet (higher than optimal blood cholesterol, blood pressure and BMI, and inadequate vegetable and fruit intakes).²

food servings and cooking habits of Pacific people. These include the 1988-1990 Workforce Diabetes survey (WDS)⁷ of 643 Pacific (395 men; 248 women) and 4,443 European people (3,297 men; 1,154 women), the 1997 National Nutrition survey (NNS)⁸ of 270 Pacific (104 men; 166 women) and 3,357 Europeans (1,451 men; 1,896 women), the 2002-2003 DHAH9

Table 1. Mean (se) age and body mass index (BMI) and geometric mean (95% confidence interval) total energy intakes and mean ratio of energy to resting metabolic rate (EI/RMR) (se) for men and women adjusted for age. Pacific men or women are compared with European men or women, and Samoan men or women with other Pacific men or women, respectively.

	European	Samoan	Tongan	Niuean	Cook	All Pacific ¹
Men						
Number	863	243	121	49	46	478
Age (years) ²	51.8 (0.29)	47.6 (0.81)***	53.7 (2.54)†	48.0 (1.57)*	50.0 (4.29)	49.7 (1.01)*
BMI (kg/m ²) ²	27.6 (0.15)	32.9 (0.47)***	34.3 (0.90)***	32.0 (0.75)***	30.8 (0.83)***	33.0 (0.39)††
Energy intake (MJ/day)	9.9 (9.6,10.1)	11.7*** (10.6,12.9)	10.7 (9.3,12.3)	11.5** (10.4,12.8)	10.6 (9.1,12.3)	11.1*** (10.4,11.9)
EI/RMR [mean(se)]	1.34 (0.02)	1.57 (0.08) ^b	1.38 (0.17)	1.50 (0.08)	1.45 (0.11)	1.48 (0.07)
Women						
Number	882	234	131	60	70	508
Age (years) ²	52.2 (0.30)	47.1 (0.82)***	48.0 (1.68)*	46.2 (1.22)***	46.1 (1.06)***	47.1 (0.58)***
BMI (kg/m ²) ²	27.3 (0.19)	36.0 (0.58)***	36.2 (1.02)***	35.1 (1.25)***†	35.2 (0.77)***	35.8 (0.42)††
Energy intake (MJ/day)	8.5 (8.3,8.8)	10.0*** (9.0,11.2)	10.0* (8.8,11.4)	11.0*** (9.9,12.3)	11.2*** (9.6,13.2)	10.3*** (9.7,11.0)
EI/RMR [mean(se)]	1.53 (0.02)	1.68 (0.09)	1.61 (0.13)	1.76 (0.09)*	1.96 (0.16)**	1.71 (0.06)*

*0.01 ≤ p < 0.05, ** 0.001 < p < 0.01, *** p ≤ 0.001 versus Europeans.

†0.01 ≤ p < 0.05 versus Samoans ; †† P < 0.001 versus Europeans.

1 The All Pacific group are compared to Europeans.

2 Not adjusted for age.

The prevalence of diabetes in Pacific people from the Diabetes, Heart and Health Survey (DHAH) was higher than in Europeans (hereon referred to a Europeans)³. Previous studies have implicated dietary patterns termed as “unhealthy”⁴, “western”⁵ or “conservative”⁶ that are high in meat, high-fat foods and sweets as predictors of diabetes, and diets high in fruit and vegetables have been termed “healthy”⁴ or “prudent”^{5,6}.

There are few studies that have reported nutrient intakes,

of 1,001 Pacific (482 men; 519 women) and 1,745 European people (863 men; 882 women) and the 2008/09 New Zealand Adult Nutrition Survey¹⁰ (NZANS) of 757 Pacific (349 men; 408 women) and 3,371 European/Other (1,497 men; 1,874 women) people.

The 1988-1990 WDS reported higher total energy intakes in Pacific people than Europeans, and that Pacific people consumed less carbohydrate, fibre and calcium, and more protein, fat, saturated fat and cholesterol.⁷ The 2002-2003 DHAH Survey

Table 2. Geometric mean (95% confidence interval) nutrient intakes expressed as a percentage contribution to total energy or nutrient energy densities (for calcium and cholesterol) adjusted for age. Samoan, Tongan, Niuean and Cook men compared with European men.

	European	Samoan	Tongan	Niuean	Cook	All Pacific
Number	863	243	121	49	46	478
Carbohydrate (%)	49.2 (48.7,49.8)	49.0 (47.6,50.4)	47.8 (45.2,50.5)	49.3 (47.0,51.7)	46.3 (43.6,49.2)	48.1 (47.0,49.3)
Starch (%)	24.1 (23.7,24.5)	24.2 (23.0,25.5)	25.0 (23.1,27.1)	26.4* (24.3,28.6)	25.5 (23.3,28.0)	24.8 (23.8,25.8)
Sucrose (%)	10.4 (10.1,10.8)	11.1 (10.2,12.1)	9.6 (7.7,11.9)	9.9 (8.4,11.6)	8.4* (7.0,10.1)	10.1 (9.3,10.9)
Fibre (g/MJ)	2.6 (2.5,2.7)	2.1*** (1.9,2.3)	2.5† (2.3,2.9)	2.3 (2.0,2.6)	2.4 (2.2,2.7)	2.3** (2.2,2.5)
Protein (%)	14.8 (14.6,15.0)	15.7** (15.2,16.3)	17.9***††† (16.9,18.9)	16.1* (15.0,17.3)	16.8*** (15.7,18.1)	16.7*** (16.2,17.1)
Total Fat (%)	33.6 (33.2,34.0)	35.4** (34.4,36.5)	34.5 (32.1,37.2)	33.8 (31.8,36.0)	36.5** (34.5,38.5)	35.2** (34.2,36.2)
SFA (%)	12.9 (12.7,13.1)	14.1*** (13.6,14.7)	14.1 (12.8,15.5)	13.3 (12.1,14.6)	14.2 (12.9,15.7)	13.9*** (13.4,14.5)
PUFA (%)	5.0 (4.9,5.1)	4.9 (4.7,5.2)	4.5 (4.0,5.2)	4.6 (4.1,5.2)	5.0 (4.5,5.5)	4.9 (4.7,5.1)
MUFA (%)	11.9 (11.6,12.0)	12.0 (11.7,12.4)	11.6 (10.7,12.5)	11.5 (10.8,12.3)	12.6 (11.7,13.6)	12.0 (11.6,12.4)
Cholesterol (mg/MJ)	33.1 (32.3,33.9)	41.7*** (39.1,44.6)	41.1*** (37.2,45.4)	41.6*** (36.8,47.0)	44.9*** (38.6,52.1)	42.4*** (40.4,44.5)
Alcohol (%)	2.6 (2.4,2.8)	0.8*** (0.7,1.1)	0.7*** (0.4,1.2)	0.9*** (0.5,1.5)	0.7*** (0.3,1.3)	0.6*** (0.5,0.7)
Calcium (mg/MJ)	88.2 (86.5,90.0)	65.8*** (62.0,69.9)	63.2*** (57.3,69.7)	68.8*** (62.4,75.8)	68.8*** (61.8,76.4)	65.8*** (63.0,68.6)

* 0.01 ≤ P < 0.05, ** 0.001 < P < 0.01, *** P ≤ 0.001 versus Europeans. ††† P ≤ 0.001 versus Samoan.

SFA = saturated fatty acids, PUFA = polyunsaturated fatty acids, MUFA = monounsaturated fatty acids.

Table 3. Geometric mean (95% confidence interval) nutrient intakes expressed as a percentage contribution to total energy or nutrient energy densities (for calcium and cholesterol) adjusted for age. Samoan, Tongan, Niuean and Cook women compared with European women.

	European	Samoan	Tongan	Niuean	Cook	All Pacific
Number	882	234	131	60	70	508
Carbohydrate (%)	51.2 (50.5,51.9)	51.3 (49.7,53.0)	51.2 (48.0,54.6)	54.4* (51.9,57.0)	50.7 (48.4,53.1)	51.3 (50.0,52.5)
Starch (%)	22.4 (21.8,22.9)	25.8*** (24.1,27.6)	26.0** (23.4,28.9)	24.0 (21.6,26.6)	23.9 (21.6,26.4)	25.4** (24.3,26.6)
Sucrose (%)	11.5 (11.0,11.9)	10.5 (9.2,11.9)	10.6 (8.8,12.8)	12.4 (10.8,104.4)	10.2 (8.6,12.3)	10.4 (9.5,11.3)
Fibre (g/MJ)	3.1 (3.0,3.2)	2.8* (2.6,3.0)	2.8 (2.2,3.5)	3.1 (2.8,3.5)	2.5 (2.0,3.2)	2.8** (2.6,3.0)
Protein (%)	15.1 (14.9,15.4)	16.6*** (16.0,17.3)	17.1*** (16.1,18.1)	16.4 (15.0,18.1)	15.6 (14.2,17.1)	16.8*** (16.3,17.3)
Total Fat (%)	32.7 (32.2,33.3)	33.8 (32.5,35.2)	33.1 (30.5,35.8)	30.5* (28.6,32.4)	33.6 (30.9,36.5)	33.2 (32.2,34.3)
SFA (%)	12.3 (12.1,12.6)	13.3* (12.6,14.1)	13.1 (12.0,14.3)	11.4* (10.6,12.2)	13.1 (11.9,14.4)	13.0 (12.5,13.5)
PUFA (%)	4.8 (4.7,4.9)	4.9 (4.6,5.2)	4.9 (4.5,5.4)	4.9 (4.2,5.6)	5.0 (4.5,5.6)	4.9 (4.7,5.1)
MUFA (%)	11.7 (11.5,12.0)	11.4 (10.9,11.9)	11.0 (9.8,12.3)	10.6** (9.8,11.3)	11.4 (10.5,12.5)	11.2 (10.8,11.7)
Cholesterol (mg/MJ)	31.2 (30.3,32.1)	38.2* (35.8,40.8)	35.2 (28.1,44.0)	30.7* (27.1,34.8)	36.3 (30.8,42.8)	37.3*** (34.6,40.2)
Alcohol (%)	1.4 (1.2,1.5)	0.1*** (0.1,0.2)	0.4* (0.2,1.0)	0.2*** (0.1,0.4)	0.2*** (0.1,0.3)	0.2*** (0.1,0.3)
Calcium (mg/MJ)	97.8 (95.7,99.7)	76.6*** (71.5,82.0)	75.1*** (68.5,82.3)	88.5 (79.2,99.9)	78.4*** (71.1,86.6)	77.6*** (74.4,81.0)

* 0.01 ≤ P < 0.05, ** 0.001 ≤ P < 0.01, *** P < 0.001 versus Europeans. † 0.001 < P < 0.01, SFA = saturated fatty acids, PUFA = polyunsaturated fatty acids, MUFA = monounsaturated fatty acids.

also reported that Pacific people reported higher total energy intakes, less calcium and alcohol, but more carbohydrate, starch, protein, total fat, saturated fat, monounsaturated fat (MUFA), and cholesterol than Europeans.⁹ Pacific women reported consuming higher amounts of fibre compared to European women.⁹ Results from the 2008/09 New Zealand Adult Nutrition Survey are difficult to interpret as they compared Pacific nutrient intakes with non-Pacific people, which included Europeans, Māori and Others.¹¹ Compared to non-Pacific women, they reported higher total energy intakes and slightly higher MUFA intakes in Pacific women. However, there were no differences between Pacific and non-Pacific people in the mean percentage of total energy from protein, fat, and carbohydrates; but Pacific people had a significantly lower median daily intake of calcium compared to non-Pacific people.¹¹ Although the 1997 NNS reported some dietary and cooking habits of Pacific people, they did not recruit sufficient Pacific people to enable nutrient comparisons with European and Other New Zealanders.⁸

No previous studies appear to have reported nutrient intakes, food servings and cooking habits in the various Pacific

ethnic groups. This issue is relevant as previous research has identified substantial ethnic variation in cardiovascular risk factors between the main Pacific groups in New Zealand.¹²⁻¹⁴

We compared dietary intakes, food group servings, cooking habits and serving sizes of Pacific people by ethnic group and Europeans for adult men and women living in Auckland to determine whether there were ethnic variations.

Subjects and Methods

The Diabetes, Heart and Health Survey was a cross-sectional study of people aged 35-74 years, carried out between January 2002 and November 2003 in the Auckland region. There were 1,011 Pacific of whom 1,001 (482 men, 519 women) completed the food frequency questionnaire (FFQ) and 1,745 Europeans (863 men, 882 women).

Adults were recruited using two sampling frames: one, a cluster sample with random starting point addresses that were obtained from Statistics New Zealand with a probability of selection proportional to the number of people living in that mesh block (response rate 61.3%); and the other was a random

Table 4. Mean serves (se or 95% confidence interval) per month (adjusted for energy and age) of major foods eaten. Pacific men are compared with European men.

	European	Samoan	Tongan	Niuean	Cook	All Pacific
Number	863	243	121	49	46	478
Red meat	31.9 (0.53)	33.4 (2.04)	49.0 (7.40)*	31.0 (3.26)	28.9 (3.07)	37.8 (2.34)**
Chicken	4.9 (0.15)	11.5 (1.12)***	11.8 (1.14)***	9.6 (1.41)***	9.9 (1.31)***	12.4 (0.83)***
Fish	8.2 (0.23)	15.7 (1.03)***	17.9 (1.70)***	16.6 (2.15)***	16.8 (3.21)**	17.9 (0.95)***
Vegetables [§]	121.7 (118.2,125.4)	104.8 (93.6,117.4)	103.9 (86.6,124.7)	107.5 (92.7,118.3)	96.2* (79.5,116.4)	104.3 (89.1,122.0)
≥ 3 serves/day ¹ (%)	75.8 (1.59)	68.1 (5.29)	69.3 (7.64)	76.6 (6.59)	62.4 (9.47)	68.4 (3.58)
Fruit	59.7 (1.59)	54.8 (13.81)	76.1 (11.81)	52.2 (9.78)	58.9 (8.85)	62.2 (7.69)
≥ 2 serves/day ² (%)	40.7 (1.81)	30.9 (4.65)	43.8 (8.74)	28.0 (7.10)	45.0 (11.21)	35.1 (4.04)
Eggs (number)	11.0 (0.36)	18.8 (1.55)***	13.4 (2.37)	19.0 (3.28)*	22.0 (4.11)**	17.8 (1.16)***
Cheese ³	14.0 (0.51)	1.0 (1.06)***	0.8 (0.87)***	2.8 (1.60)***	7.2 (2.08)***	2.6 (0.59)***
Milk (cups per month) [§]	65.3 (59.4,71.8)	26.8*** (20.9,34.3)	12.8*** (8.2,19.9)	28.9** (17.6,47.4)	34.0 (15.7,73.4)	24.3*** (19.6,30.1)
Bread (slices)	24.5 (0.48)	30.2 (1.99)**	32.4 (4.37)	36.9 (3.23)***	39.1 (5.64)**	32.6 (.69)***
Breakfast Cereal	15.7 (0.48)	4.7 (0.92)***	2.9 (1.29)***	6.0 (1.39)***	8.5 (1.47)*	4.7 (0.68)***
Coconut cream [§]	0.04 (1.02) (0.04,0.04)	3.1*** (2.6,3.8)	3.9*** (2.6,5.8)	3.1*** (2.2,4.4)	2.1*** (1.0,4.4)	3.2*** (2.4,4.2)

* 0.01 ≤ P < 0.05, 0.001 < P < 0.01, *** P ≤ 0.001 versus Europeans. † 0.01 < P < 0.05, ††† P ≤ 0.001 versus Samoan.

1. Serves of vegetables per day. 2. Serves of fruit per day. 3. Excludes low fat cheese. § Geometric mean (95% tolerance factor).

Table 4. Mean serves (se or 95% confidence interval) per month (adjusted for energy and age) of major foods eaten. Pacific men are compared with European men.

	European	Samoan	Tongan	Niuean	Cook	All Pacific
Number	863	243	121	49	46	478
Red meat	31.9 (0.53)	33.4 (2.04)	49.0 (7.40)*	31.0 (3.26)	28.9 (3.07)	37.8 (2.34)**
Chicken	4.9 (0.15)	11.5 (1.12)***	11.8 (1.14)***	9.6 (1.41)***	9.9 (1.31)***	12.4 (0.83)***
Fish	8.2 (0.23)	15.7 (1.03)***	17.9 (1.70)***	16.6 (2.15)***	16.8 (3.21)**	17.9 (0.95)***
Vegetables [§]	121.7 (118.2,125.4)	104.8 (93.6,117.4)	103.9 (86.6,124.7)	107.5 (92.7,118.3)	96.2* (79.5,116.4)	104.3 (89.1,122.0)
≥ 3 serves/day ¹ (%)	75.8 (1.59)	68.1 (5.29)	69.3 (7.64)	76.6 (6.59)	62.4 (9.47)	68.4 (3.58)
Fruit	59.7 (1.59)	54.8 (13.81)	76.1 (11.81)	52.2 (9.78)	58.9 (8.85)	62.2 (7.69)
≥ 2 serves/day ² (%)	40.7 (1.81)	30.9 (4.65)	43.8 (8.74)	28.0 (7.10)	45.0 (11.21)	35.1 (4.04)
Eggs (number)	11.0 (0.36)	18.8 (1.55)***	13.4 (2.37)	19.0 (3.28)*	22.0 (4.11)**	17.8 (1.16)***
Cheese ³	14.0 (0.51)	1.0 (1.06)***	0.8 (0.87)***	2.8 (1.60)***	7.2 (2.08)**†	2.6 (0.59)***
Milk (cups per month) [§]	65.3 (59.4,71.8)	26.8*** (20.9,34.3)	12.8**** (8.2,19.9)	28.9** (17.6,47.4)	34.0 (15.7,73.4)	24.3*** (19.6,30.1)
Bread (slices)	24.5 (0.48)	30.2 (1.99)**	32.4 (4.37)	36.9 (3.23)***	39.1 (5.64)**	32.6 (.69)***
Breakfast Cereal	15.7 (0.48)	4.7 (0.92)***	2.9 (1.29)***	6.0 (1.39)***	8.5 (1.47)*	4.7 (0.68)***
Coconut cream [§]	0.04 (1.02) (0.04,0.04)	3.1*** (2.6,3.8)	3.9*** (2.6,5.8)	3.1*** (2.2,4.4)	2.1*** (1.0,4.4)	3.2*** (2.4,4.2)

* 0.01 ≤ P < 0.05, 0.001 < P < 0.01, *** P ≤ 0.001 versus Europeans. † 0.01 < P < 0.05, †† P ≤ 0.001 versus Samoan.
 1. Serves of vegetables per day. 2. Serves of fruit per day. 3. Excludes low fat cheese. § Geometric mean (95% tolerance factor).

sample taken from the November 2000 Auckland electoral rolls stratified into 5-year age bands and included all people living in the Auckland area (response rate 60%). Participants were interviewed in places close to where they lived and all completed a self-administered food frequency questionnaire.

Classification of ethnicity gave priority to Māori (who were not included in this report) then to Pacific and then to European ethnicity. This is similar to the method used by the New Zealand Ministry of Health.¹⁵ Those who were of Pacific and non-Māori ethnicity were assigned to their respective Pacific ethnic group. Those who belonged to more than one Pacific ethnic group were assigned to the smaller Pacific group as done by Census 2001.¹⁶ This gave priority firstly to Niuean, followed by Cook Islands, Tongan, and lastly Samoan ethnicity. Small numbers of Fijian (n=21) and ‘Other Pacific’ (n=26) participants meant that analysis of their results would not provide reliable findings and their observations were excluded. Ethical Committee approval was obtained from the Ministry of Health Auckland Ethics Committees.

Food intake over the previous 3 months was estimated by a 142-item food frequency questionnaire (FFQ) that included foods eaten by Pacific Island people (e.g. povi masima (salty corned beef), shellfish (pipis, mussels, oysters), coconut cream, green bananas, kumara (sweet potato), yam, and taro tuber. The FFQ was filled in by participants at their home, and checked for errors and omissions at their interview the following morning. Serving sizes of vegetables, meat, fish and cake were assessed using colour photographs of foods that participants used to rank themselves into three portion size groups (more, same, less). These were scaled as less 0.5, same 1.0, and more 1.6. Otherwise pre-portioned serving sizes, such as the average weight of a piece of fruit, or slice of bread were used or published serve sizes.¹⁷ The comprehensive version of the New Zealand food composition tables¹⁸ was used to calculate nutrient intakes. We have previously reported that this FFQ was valid and reproducible in European, and Māori and Pacific Islands participants.¹⁹

The resting metabolic rate (RMR), which is the total

Table 5. Mean serves (se) per month (adjusted for energy and age) of major foods eaten. Pacific women are compared with European women.

	European	Samoan	Tongan	Niuean	Cook	All Pacific
Number	882	234	131	60	70	508
Red meat	27.8 (9.57)	28.3 (1.82)	36.9 (3.93)**	26.3 (3.69)	26.2 (2.95)	30.1 (1.26)
Chicken	5.5 (0.17)	12.1 (0.96)***	9.7 (1.35)**	9.3 (1.00)***	10.9 (1.33)***	11.1 (0.59)***
Fish	8.9 (0.32)	17.3 (1.52)***	20.5 (2.93)***	19.5 (3.90)**	19.6 (4.87)*	19.4 (1.25)***
Vegetables [§]	151.9 (151.9,156.5)	134.5 (119.0,152.0)	137.5 (107.4,176.0)	193.9 (139.5,269.5)	91.8 (54.3,155.1)	138.2 (122.3,152.0)
≥ 3 serves/day ¹ (%)	86.6 (1.28)	80.4 (4.73)	78.7 (7.63)	85.1 (5.61)	71.3 (9.60)*	79.3 (3.77)
Fruit	94.1 (1.59)	78.9 (8.77)	84.2 (9.10)	116.0 (17.38)	76.8(15.44)	87.4 (5.87)
≥ 2 serves/day ² (%)	56.8 (1.81)	38.9 (5.11)**	51.1 (7.44)	68.9 (7.84)**	41.2 (7.69)*	44.5 (3.82)
Eggs (number)	9.2 (0.35)	14.4 (1.63)***	11.7 (2.18)	8.6 (1.10)	16.3 (3.94)	14.5 (1.36)***
Cheese ³	15.5 (0.51)	2.8 (0.67)***	3.8 (1.50)***	7.7 (3.08)*	2.3 (1.47)***	3.9 (0.65)***
Milk (cups per month) [§]	57.5 (52.3,64.4)	39.3* (28.6,52.1)	23.1**** (17.8,30.0)	54.6 (37.7,79.2)	41.9 (26.0,67.5)	39.7*** (32.0,49.2)
Bread (slices)	19.5 (0.46)	29.9 (1.81)***	32.4 (2.28)***	24.5 (3.00)***	27.8 (2.31)***	30.6 (1.20)***
Breakfast Cereal	16.8 (0.80)	10.6 (1.35)***	4.9 (1.62)***	11.8 (2.14)*	9.7 (2.25)**	9.3 (0.95)***
Coconut cream [§]	0.1 (0.1,0.1)	3.2*** (2.5,3.9)	5.2*** (3.1,8.8)	3.9*** (3.2,4.9)	1.6*** (1.1,2.2)	3.4*** (2.7,4.3)

* 0.01 < P < 0.05, ** 0.001 < P < 0.01, *** P < 0.001 versus Europeans. † 0.01 < P < 0.05, †† P < 0.001 versus Samoan.
 1. Serves of vegetables per day. 2. Serves of fruit per day. 3. Excludes low fat cheese. § Geometric mean (95% tolerance factor).

Table 6. Common cooking practices in percent (se) by gender and ethnicity.

Cooking Practice	European	Samoan	Tongan	Niuean	Cook	P-value
Men						
Number	863	243	121	49	46	
Meat Fry or Roast	36.2 (1.79)	21.3 (3.94)**	28.3 (8.35)	29.3 (7.64)	65.6 (8.75)****	0.0011
Boil in Water	3.1 (0.68)	46.6 (5.16)***	56.2 (8.72)***	19.0 (4.93)****	16.1 (5.26)****	<0.0001
Grill	26.0 (1.60)	15.4 (2.66)**	12.6 (5.82)	28.1 (7.65)	4.1 (2.39)****	0.0007
Vegetables Fry or Roast	3.9 (0.74)	10.0 (2.19)**	0.0	0.0	6.0 (4.20)	-
Boil or Steam	68.7 (1.78)	80.0 (3.06)**	95.4 (2.03)****	88.1 (5.47)*	91.8 (4.75)**	<0.0001
Meat & Vegetables Fry in Vegetable Oils	82.6 (1.46)	77.3 (3.25)	68.8 (7.89)*	73.7 (7.07)	62.2 (11.99)*	0.0075
Fry in Butter, Lard or Dripping	5.2 (0.86)	12.1 (2.34)***	16.0 (6.08)**	7.8 (4.08)	28.9 (12.85)***	<0.0001
Roast in Vegetable Oils	53.2 (1.85)	40.4 (5.41)*	52.4 (8.94)	37.9 (8.00)	49.0 (10.98)	0.1491
Dry Roast	38.0 (1.83)	44.4 (5.16)	39.2 (8.78)	47.3 (8.24)	41.7 (9.98)	0.7081
Women						
Number	882	234	131	60	70	
Meat Fry or Roast	31.6 (1.71)	18.6 (3.08)**	4.3 (1.82)****	11.4 (5.19)**	34.6 (7.21)†	< 0.0001
Boil in Water	3.1 (0.64)	38.1 (5.13)***	67.8 (11.08)***	21.8 (6.51)***	24.1 (9.62)***	<0.0001
Grill	30.7 (1.70)	33.5 (5.41)	24.5 (11.60)	47.3 (11.24)	23.8 (6.19)	0.5439
Vegetables Fry or Roast	4.3 (0.77)	16.5 (4.74)***	2.9 (1.85)†	0.0	2.3 (2.29)†	-
Boil or Steam	66.8 (1.75)	74.1 (4.91)	88.9 (3.73)****	74.5 (10.81)	82.5 (5.47)*	0.0054
Meat & Vegetables Fry in Vegetable Oils	79.9 (1.57)	66.9 (5.66)*	77.4 (6.10)	76.7 (6.87)	62.8 (6.89)***	0.0070
Fry in Butter, Lard or Dripping	3.4 (0.67)	17.2 (5.37)***	11.6 (3.98)**	5.6 (3.35)†	10.2 (4.24)*	<0.0001
Roast in Vegetable Oils	52.5 (1.88)	33.3 (5.52)**	46.9 (7.69)	49.5 (11.18)	23.1 (5.75)***	0.0005
Dry Roast	40.8 (1.86)	57.0 (5.58)**	43.1 (7.52)	42.7 (11.19)	70.7 (6.34)***	0.0017

* 0.01 < P < 0.05, ** 0.001 < P < 0.01, *** P < 0.001 versus Europeans. † 0.01 < P < 0.05, †† 0.001 < P < 0.01, ††† P < 0.001 versus Samoan.

minimum activity of all tissue cells of the body under steady state conditions, is expressed as the rate of heat production or oxygen consumption related to some unit of body size,²⁰ and was calculated using the standard equations of Schofield:²¹

Males: $RMR = 0.048 \times \text{weight (in Kg)} - 0.011 \times \text{height (in m)} + 3.670$.

Females: $RMR = 0.068 \times \text{weight (in kg)} + 0.574 \times \text{height (in m)} + 2.157$.

Minimal requirements for the ratio of total energy intake (in MJ) to resting metabolic rate (EI/RMR) is 1.55 by WHO criteria and 1.38 according to Goldberg et al.²² and can be used as a guide for under-reporting of food intake.

Participant data were weighted according to the sampling frame that they were obtained from and means and standard errors calculated using dual frame sampling methodology²³⁻²⁵ and SAS survey procedures.²⁶ Because of the positively skewed frequency distribution of nutrient intakes, these were converted to logs for calculations; the results presented are geometric means (the exponential of the log-transformed data) and associated 95% confidence interval. As food servings were approximately normally distributed after adjusting for total energy intakes, these are presented as means and standard errors. Although we made multiple comparisons, a two-tailed p value of < 0.05 was the criterion for statistical significance due to the small number of Pacific ethnic groups. Analyses compare each Pacific ethnic group to their European and Samoan counterparts. Samoans were used as the intra-Pacific reference group as they comprised the largest Pacific sample.

Comparisons with the 'All Pacific' group have been published previously⁹, and have been included here so that an assessment of whether apparent differences between the Pacific groups may just be a combination of random and measurement

error. No comments have been made regarding the 'All Pacific' group.

Results

Table 1 shows mean (se) age and body mass index (BMI) and geometric mean total energy intakes, and the ratio of energy intake to resting metabolic rate (EI/RMR) in men and women by ethnicity after adjusting for age. Age was significantly lower in Samoan and Niuean men compared to European men, and age was lower in women of all Pacific ethnic groups compared to European women. On average, Tongan men were older than Samoan men. BMI was higher in all Pacific adults compared to European adults. On average, Niuean women had a lower BMI than Samoan women. Total energy intakes per day in Pacific men were higher than European men, although the differences were only significant for Samoan and Niuean men, while for women, total energy intakes were significantly higher in all Pacific ethnic groups compared to Europeans. The EI/RMR was higher in Samoan men compared to European men, and for Niuean and Cook women compared to European women.

Nutrients expressed as percentage contribution to total energy intakes (Table 2) showed that Pacific men had lower alcohol and calcium (expressed as a nutrient density), and higher protein and cholesterol (expressed as a nutrient density) intakes compared to European men. The largest male Pacific group, Samoans, had lower intakes of fibre and higher intakes of SFA expressed as their percentage contribution to total energy intakes compared to European men. Other significant differences were inconsistent and may represent random or measurement error.

All Pacific women had lower intakes of alcohol and calcium expressed as their contribution to total energy intake

Table 7. Percentages (se) reporting eating larger than the standard serving size by gender and ethnicity.

Food	European	Samoan	Tongan	Niuean	Cook	P-value
Men						
Number	863	243	121	49	46	
Chicken	26.0 (1.64)	40.5 (5.12)**	38.0 (7.90)**	39.0 (7.93)	41.7 (9.98)	<0.0001
Fish	48.7 (1.88)	47.8 (5.14)	66.0 (8.28)**†	61.4 (7.58)	53.4 (11.02)	0.0073
Red Meat	25.1 (1.63)	40.6 (5.29)***	27.5 (6.73)	43.7 (8.20)**	26.6 (8.15)	<0.0001
Cheese	37.6 (1.84)	20.2 (5.35)***	15.6 (6.71)***	30.0 (8.24)***	22.3 (8.59)	<0.0001
Potato, Kumara or Taro	48.7 (1.87)	53.6 (5.02)	70.2 (7.56)*	77.7 (5.95)****	33.6 (8.90)†††	0.0003
Other Vegetables	32.8 (1.72)	46.0 (5.12)**	60.0 (7.98)****	48.0 (8.04)*	42.1 (9.91)	<0.0001
Cakes or Desserts	13.1 (1.36)	22.7 (5.30)***	6.1 (2.51)****	15.6 (6.69)	23.0 (8.55)	<0.0001
Women						
Number	882	234	131	60	70	
Chicken	7.6 (1.00)	34.1 (5.56)***	27.5 (8.04)***	26.4 (11.03)**	44.7 (8.23)***	<0.0001
Fish	25.5 (1.61)	35.1 (5.05)*	61.4 (7.34)****††	37.1 (10.70)	67.4 (6.96)****†††	<0.0001
Red Meat	5.6 (0.88)	21.0 (5.09)***	20.5 (7.58)**	14.1 (5.69)	47.6 (9.22)****†††	<0.0001
Cheese	27.2 (1.66)	14.9 (2.73)***	14.8 (4.95)**	13.3 (5.39)**	31.7 (10.65)†	<0.0001
Potato, Kumara or Taro	18.1 (1.41)	36.9 (4.80)***	33.2 (7.45)*	28.0 (7.44)	46.4 (8.11)***	<0.0001
Other Vegetables	31.8 (1.72)	51.0 (5.41)**	59.7 (9.14)***	61.4 (10.61)**	40.0 (39.90)	<0.0001
Cakes or Desserts	8.8 (1.15)	10.7 (2.55)***	11.5 (4.11)***	11.3 (5.08)**	28.3 (10.26)**†	<0.0001

* 0.01 < P < 0.05, ** 0.001 < P < 0.01, *** P < 0.001 versus Europeans. † 0.01 < P < 0.05, †† 0.001 < P < 0.01, ††† P < 0.001 versus Samoan.

compared to European women (Table 3), that were not statistically significant for Niuean women. Protein and cholesterol intakes expressed as their contribution to total energy intakes were higher in Pacific women than European women, but these were not statistically significant in all Pacific ethnic groups. Other significant differences were inconsistent among the different ethnic groups.

Mean energy and age-adjusted serves per month of major food groups for men are shown in Table 4. Compared to European men, all Pacific men had fewer servings of cheese, cereal and milk and more servings of chicken, fish, and coconut cream and Samoan, Tongan and Cook Islands men reported eating more bread and fewer eggs. Other differences were inconsistent between ethnic groups.

Compared to European women, all Pacific women reported eating more servings of chicken, fish, bread and coconut cream, and fewer servings of cheese and breakfast cereal per month (Table 5). Other differences were inconsistent.

There were significant ethnic differences in the type of milk consumed (both P < 0.001), with 80.8% of Samoan, 71.5% of Tongan, 78.6% of Cook Island, and 56.2% of Niuean men compared to 45.7% of European men drinking whole or homogenized milk; and 78.5% of Cook Islander, 70.9% of Tongan, 67.1% of Samoan, and 55.9% of Niuean women compared to 32.2% of European women drinking whole or homogenized milk. Low fat milks were favoured by 51.5% of European men, 39.2% of Niuean, 19.3% of Cook Island, 16.1% of Samoan, and 14.9% of Tongan men; and 64.0% of European, 41.7% of Niuean, 29.1% of Tongan, 28.5% of Samoan, and 21.5% of Cook Island women. Between 2.2 and 13.6 percent of men and 0.0 to 4.3% of women did not consume milk.

Discretionary use of salt also differed significantly (both P < 0.001) among ethnic and gender groups with 41.4% of Samoan, 40.6% of Cook Island men, 40.2% of Tongan, and 9.1% of Niuean men compared to 28.4% of European men usually adding salt to their meals; and 33.3% of Tongan, 26.3% of Cook

Island, 25.2% of Samoan, 12.6% of Niuean women compared to 19.0% of European women. About 31% of Cook Island, 19% of Tongan, 18% of Niuean and 8% of Samoan men rarely or never added salt to their meals compared with 43% of European men; and 43% of Cook Island, 41% of Niuean, 13% of Samoan, and 10% of Tongan women rarely or never added salt to their meals compared to 52% of Europeans women.

Butter use as a spread was slightly higher in Tongan (30.9%), Niuean (29.0), Cook Island (27.8%) and Samoan (25.6%) men compared to European men (19.4%); and Samoan (32.0%), Tongan (24.5%), Cook Island (22.2%) and European (18.1%) women compared to Niuean (8.9%) women. Margarine use as a spread was higher in European (60.1%) men than Cook Island (56.8%), Samoan (52.8%), Tongan (47.3%), and Niuean (44.7%) men; and higher in Niuean (63.6%) women compared to Cook Island (62.2%), Tongan (56.4%), European (53.1%) and Samoan (48.8%) women. Neither butter nor margarine were used as a spread by 13.3% of European, 9.1% of Tongan, 2.9% of Niuean, 2.2% of Cook Island and 1.7% of Samoan men; and 22.4% of European, 10.3% of Niuean, 4.1% of Samoan, 3.6% of Cook Island, and 2.6% of Tongan women (both P < 0.001).

Common methods of cooking meats and vegetables are shown in Table 6. The most common meat cooking method among Pacific men and women was boiling in water and vegetables were more likely to be boiled or steamed compared to European adults. Samoan, Tongan, and Cook Islands men and women were more likely to fry meat and vegetables in animal fats such as butter, lard, or dripping. There were no significant differences between the male ethnic groups in those that ate all or most of the fat on meat (P = 0.453).

Samoan, Tongan and Niuean women were less likely to fry or roast meat compared to European women. Higher proportions of Cook Islands women (23.3%) compared to European women (8.2%) reported eating all or most of the fat on meat (P < 0.001).

In general, higher percentages of Pacific men reported eating larger than the standard portions of chicken and vegetables

(other than potato, kumara or taro) and smaller portions of cheese compared to European men (Table 7).

Compared to European women (Table 7), all Pacific women reported eating larger servings of chicken, fish, red meat, potato, kumara or taro, other vegetables and cake or dessert and lower percentages reported eating large portions of cheese.

Discussion

Results from the current study show that there were major differences in dietary nutrient intakes, food group servings, cooking practices and serving sizes between the Pacific ethnic groups, as well as between Pacific and European people. However, there were also many similarities of dietary intakes amongst the Pacific groups that were quite different to that observed in European participants. It is noted that the numbers of study participants in some of the different Pacific ethnic groups were small and unlikely to provide precise estimates. In the future, it would be desirable to collect larger numbers of the different Pacific ethnic groups to enable more meaningful comparisons of their dietary intakes. This study appears to be the first that has reported dietary habits in the different Pacific groups.

The higher total energy intakes in Samoan and Niuean men and all female Pacific ethnic groups compared to Europeans (Table 1) were also reported by the 1988 WDS survey that reported intakes in Pacific men and women compared to European men and women, respectively.⁷ However, the 2008/2009 NANS reported a significant difference in total energy intakes between Pacific and non-Pacific women only.¹¹

Nutrients expressed as percentage contribution to total energy intakes (Tables 2 and 3) showed that all Pacific men and most Pacific women had lower alcohol and calcium, and higher protein and cholesterol intakes compared to Europeans. Similar results were reported by the 1988 WDS survey.⁷ The 1997 NNS also reported lower servings of cheese and alcohol,⁸ whereas the 2008/09 NZANS reported no significant differences in protein intakes between Pacific and non-Pacific, but did find lower calcium nutrient densities in Pacific men and women.¹¹

Nutrient findings in men were reflected by fewer servings of cheese, milk and cereal and higher servings of chicken, fish, eggs and bread in Pacific compared to European men. Compared to European women, all Pacific women ate more servings of chicken, fish and bread and less servings of cheese and breakfast cereal per month and also reflected their nutrient findings. The WDS survey reported similar findings.⁷ The NNS also reported more servings of chicken and fish in Pacific adults, smaller proportions of Pacific men and women reported eating ≥ 3 servings of vegetables per day and a larger proportion of Pacific men and women reported eating ≤ 1 serving of fruit per day, compared to European men and women, respectively.⁹ In the current study, only Cook Islands men had a smaller proportion reported eating ≥ 3 servings of vegetables per day; and a smaller proportion of Samoan women reported eating ≥ 2 servings of fruit per day, compared to European men and women, respectively. The NZ Ministry of Health has recommended that adults eat at least 3 servings of vegetables and at least 2 servings of fruit each day.¹⁷ Using this definition, the 2002-2003 NZHS reported that European males and females were more likely than Pacific males and females to report eating 3 or more servings of vegetables each day.²⁷

There were significant ethnic differences in men and women in the type of milk consumed with more Samoan, Tongan and Cook Islands men and women favouring whole or homogenised milk, whereas more European and Niuean men and women favoured low-fat milks. The WDS,⁷ NNS⁸ and NANS¹¹ all reported that more Pacific men and women drank whole or homogenised milk compared to European or non-Pacific men and women.

Discretionary use of salt at the table also varied between ethnic groups. More Pacific men usually added salt compared to European men and more Tongan, Cook Island and Samoan women usually added salt compared to European and Niuean women. The NANS¹¹ reported few differences between Pacific and non-Pacific men and women in the use of iodised salt.

The most common meat cooking method among Pacific adults was boiling in water and vegetables were boiled or steamed compared to European adults. The WDS also reported that Pacific people preferred to boil their meat and to prefer animal fats when frying or roasting meat and vegetables compared to European men and women.⁷ In the current study, more Samoan, Tongan, and Cook Islands men and women reported frying meat and vegetables in butter, lard or dripping than Europeans (Table 6). Cooking methods are important because they account, in part, for the higher intakes of saturated fats in Samoan men and women and cholesterol in all Pacific men and Samoan women compared with European men and women, respectively. In addition, the greater frequencies of eating coconut cream (a food very high in saturated fats) in all Pacific groups will have contributed to the saturated fat intakes (Tables 4 and 5).

In the current study, there were ethnic differences in reported serving sizes. Greater percentages of Samoan, Tongan and Niuean men and women reported eating larger than the standard portions of other vegetables (than potato, kumara or taro) and smaller portions of cheese compared to European men and women, respectively. There were other serving size differences in the different ethnic groups that were not so consistent. The WDS reported larger serving sizes for Pacific men and women for chicken and fish, potatoes, kumara and taro and other vegetables and a smaller serving size for cheese.⁷

We have previously reported that health-related socioeconomic characteristics in the Pacific ethnic groups living in New Zealand tended to parallel the average length of time that the ethnic group had lived in New Zealand.¹³ Niueans had lived in New Zealand an average of 30.5 years, followed by Cook Islanders (25.9 years), Samoans (22.9 years) and Tongans (14.2 years). The Cook Island and Niuean ethnic groups generally had a similar and more favourable socioeconomic profile compared to the Samoan and Tongan ethnic groups.¹³ From Table 2, there does not appear to be any appreciable differences in the nutrient intakes of Pacific men. However, Niuean women appear to have nutrient intakes that are more similar to the diets of European women (Table 4), followed by Cook Islands women. The nutrient intakes of Samoan and Tongan men and women appear to be most similar (Tables 3 and 4). However, differences between New Zealand Europeans and Pacific groups may reflect real differences in dietary intakes or may be due to residual confounding of socioeconomic status.

Diets high in meat and fat have been reported to increase the risk of diabetes in Japanese Americans, Native Hawaiians

and Caucasians.²⁸ Diets low in fruit and vegetables have been implicated in the development of ischaemic heart disease, stroke, colorectal cancer, gastric cancer, lung cancer, oesophageal cancer.²⁹ On the other hand, eating more fruit and vegetables has been associated with a reduced risk of all-cause, cancer and cardiovascular disease mortality.³⁰ Increased dietary calcium intakes as dairy products and milk have been shown to reduce the risk of osteoporosis.³¹ Eating large portion sizes is one of the biggest problems leading to weight gain.

Strengths and limitations Major strengths of the current study are its size, and its community-based sample. A limitation of the FFQ is that participants are required to estimate their usual daily or weekly consumption of foods rather than measuring "actual" dietary intakes.³² It is also possible that some participants may over- or underestimate the frequency of food intakes. Compared to the cut-off level of 1.38 for the EI/RMR,²² European men may be systematically underestimating frequencies of intakes (Table 1). On the other hand, Pacific women were least likely to underestimate dietary intakes (Table 1). However, this effect of over- and underestimation of energy intake on ethnic comparisons of nutrient intakes is minimized by expressing nutrient intakes as their percentage contribution to total energy intakes (Tables 2 and 3) and making group comparisons.³²

It was not possible to determine whether the ethnic differences reported in the current study would apply to all regions

in New Zealand, as there have been insufficient Pacific people in previous national studies to report food intake by region. However, as 67.1% of Pacific people live in the Auckland region,³³ the current results are probably representative of Pacific people living in New Zealand.

Although there were relatively few dietary differences between the different Pacific ethnic groups, this was probably due, in part, to their small numbers, particularly for Niuean and Cook Island men and women. However, some statistically insignificant nutrient differences had the same or larger geometric mean intakes as the Samoan group (that did attain statistical significance).

Conclusions

There were differences in dietary habits, food selections and cooking practices between European and Pacific participants. The ethnic differences tended to be related to larger serving sizes among Pacific people and increased frequency of eating some food groups and less of others. Strategies targeting serving sizes and the frequency of consumption of certain foods rather than the range of foods consumed may best help address the major ethnic disparities in nutrition-related health problems experienced disproportionately by Pacific communities in New Zealand.

ACKNOWLEDGMENTS: This survey was funded by the Health Research Council of New Zealand. We thank the technical and clerical staff who conducted the study so capably and efficiently. We gratefully acknowledge the Ministry of Health (Public Intelligence) and Crop and Food Research for providing a complimentary copy of FOODfiles to assist with dietary assessment.

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