A Focus on Māori Nutrition

Findings from the 2008/09 New Zealand Adult Nutrition Survey

Citation: Ministry of Health. 2012. *A Focus on Māori Nutrition: Findings from the 2008/09 New Zealand Adult Nutrition Survey*. Wellington: Ministry of Health.

Published in February 2012 by the
Ministry of Health
PO Box 5013, Wellington 6145, New Zealand

ISBN 978-0-478-37385-1 (online)
HP 5446

This document is available at www.health.govt.nz

Authors

This report was written by Sally Mackay, Dr Niki Stefanogiannis and Maria Turley, with statistical analyses conducted by Dr Deepa Weerasekera and Robert Templeton. The authors are in the Health and Disability Intelligence Unit at the Ministry of Health.

Acknowledgements

Thank you to the many thousands of New Zealanders who gave their time to participate in the 2008/09 New Zealand Adult Nutrition Survey. This report would not have been possible without your generosity.

In particular, the authors would like to thank the University of Otago, who conducted the survey, and CBG Health Research Ltd, who recruited participants into the survey.

The authors would also like to thank Anthea Hewitt for her help with preparing this report.

The content of this report, in particular the introductory statements for each section, has drawn heavily from *A Focus on Nutrition*. The authors of this report were:

Chapter 1	Sally Mackay, Ministry of Health; Associate Professor Winsome Parnell, University of Otago
Chapter 2	Dr Anne-Louise Heath, Dr Rachel Brown, Associate Professor Winsome Parnell, Dr Noela Wilson, Andrew Gray, University of Otago; Maria Turley, Sally Mackay, Dr Deepa Weerasekera, Ministry of Health
Chapters 3–5	Associate Professor Winsome Parnell, Liz Fleming, University of Otago
Chapter 6	Sally Mackay, Ministry of Health
Chapter 7	Associate Professor Winsome Parnell, University of Otago
Chapter 8	Associate Professor Winsome Parnell, Dr Noela Wilson, Professor Christine Thomson, University of Otago; Sally Mackay, Dr Niki Stefanogiannis, Maria Turley, Ministry of Health
Chapter 9	Associate Professor Winsome Parnell, University of Otago; Maria Turley, Dr Niki Stefanogiannis, Ministry of Health

The *Methodology Report for the 2008/09 New Zealand Adult Nutrition Survey* provides further information on contributions to data collection and analysis.

All Health and Disability Intelligence publications are subject to peer review by experts in their fields. This report was peer reviewed by internal and external reviewers, who provided valuable insight and contributions to this document.

Contents

Authors iii

Acknowledgements iv

Executive summary vii

1 Introduction 1
- Background 1
- How is this report different from *A Focus on Nutrition*? 1
- Overview of the survey 1
- Methods 2
- How to interpret tables in this report 7

2 Energy and macronutrient intake 8
- Energy 8
- Protein 8
- Fat 8
- Carbohydrate 9
- Dietary fibre 9
- Time trends in energy and macronutrient intake 11

3 Micronutrient intake 12
- Vitamins 12
- Minerals 13

4 Dietary supplements 16

5 Dietary habits 17
- Consumption of breakfast 17
- Vegetable and fruit intake 17
- Consumption of bread 19
- Consumption of milk 20
- Consumption of fish and shellfish 20
- Consumption of processed meat 22
- Consumption of butter and margarine 23
- Use of cooking fat 24
- Trimming fat from meat and removing skin from chicken 25
- Use of salt 26
- Consumption of pre-prepared foods 26
- Consumption of soft drinks or energy drinks 27

6 Household food security 29

7 Nutrition-related health outcomes 31
Body mass index and body size 31
Blood pressure 33
Cholesterol 34
Diabetes and HbA1c 35
Folate status 37
Iron status 38
Iodine status 40

References 42

List of tables

Table 2.1: Median energy and macronutrient intake, Māori, by sex 10
Table 2.2: Median energy and contribution of macronutrients to daily energy, Māori, by sex,[1] 1997 and 2008/09 11
Table 3.1: Median usual daily intake of selected vitamins, Māori, by sex 13
Table 3.2: Median daily usual intake of selected minerals, Māori, by sex 15
Table 4.1: Dietary supplement use in the past 12 months, Māori, by sex 16
Table 5.1: Consumption of breakfast, Māori, by sex 17
Table 5.2: Vegetable and fruit intake, Māori, by sex 18
Table 5.3: Vegetable and fruit intake, Māori, by sex,[1] 1997 and 2008/09 18
Table 5.4: Type of bread selected most of the time among those who eat bread, Māori, by sex 19
Table 5.5: Type of milk[2] selected most of the time, Māori, by sex 20
Table 5.6: Frequency of eating fresh or frozen fish or shellfish, Māori, by sex 21
Table 5.7: Frequency of eating canned fish or shellfish, Māori, by sex 21
Table 5.8: Frequency of eating battered or fried fish or shellfish, Māori, by sex 22
Table 5.9: Frequency of eating processed meat, Māori, by sex 23
Table 5.10: Type of spread used most of the time, Māori, by sex 24
Table 5.11: Type of cooking fat used most of the time, Māori, by sex 25
Table 5.12: Trimming fat from meat and removing skin from chicken, Māori, by sex 25
Table 5.13: Use of salt, Māori, by sex 26
Table 5.14: Consumption of pre-prepared foods, Māori, by sex 27
Table 5.15: Soft drink or energy drink consumption, Māori, by sex 28
Table 6.1: Household food security, Māori, by sex 29
Table 6.2: Household food security, Māori, by sex,[1] 1997 and 2008/09 30
Table 7.1: Mean body mass index, Māori, by sex 31
Table 7.2: Body size, Māori, by sex 32
Table 7.3: Body size, Māori, by sex,[1] 1997 and 2008/09 33
Table 7.4: Blood pressure, Māori, by sex 33
Table 7.5: Cholesterol, Māori, by sex 34
Table 7.6: Cholesterol, Māori, by sex,[1] 1997 and 2008/09 35
Table 7.7: HbA1c and diabetes, Māori, by sex 36
Table 7.8: Folate status, Māori, by sex 38
Table 7.9: Iron status, Māori, by sex 39
Table 7.10: Iron status, Māori women, 1997 and 2008/09[1] 40
Table 7.11: Iodine status, Māori, by sex 41

Executive summary

This report presents key findings on energy and nutrient intake, dietary supplement use, dietary habits, nutrition-related health and food security for Māori from the 2008/09 New Zealand Adult Nutrition Survey.

Energy, macronutrient and micronutrient intake

Energy is required in the body for metabolic processes, physiological functions, muscular activity, heat production, growth and the synthesis of new tissues. The macronutrients (protein, carbohydrate, fat and alcohol) from food and drinks are the only sources of energy for humans.

Vitamins and minerals (micronutrients) are nutrients needed in small amounts. This report includes findings for the median usual daily intakes of vitamins A and B (riboflavin and B_{12}) and the minerals calcium, zinc and selenium.

The median daily energy intake from foods and beverages was 11,449 kJ for Māori males and 7632 kJ for Māori females. Māori males had a significantly higher energy intake compared to non-Māori males, after adjustment for age.

Māori males and females consumed a higher mean percentage of energy from total fat, saturated fat and monounsaturated fat than non-Māori males and females, after adjusting for age.

There was a decrease in the contribution of saturated fat to energy intake from 1997 to 2008/09 for females (15.6% to 14.2%). However, this contribution is still above the recommended 10% contribution of saturated fat to energy.

There were no changes in the contribution of carbohydrates or protein to total energy intake between 1997 and 2008/09 for Māori males or females.

There were no significant differences in the median usual daily intake of vitamin A, riboflavin and vitamin B_{12} between Māori and non-Māori. There were also no differences between Māori and non-Māori in the usual median daily intake of calcium, zinc and selenium.

Dietary supplement use

About one-third of Māori males and females had consumed a dietary supplement at any time in the past 12 months. Māori males and females were significantly less likely to have taken supplements in the past 12 months compared to non-Māori males and females.

Dietary habits

Dietary habits and eating patterns are associated with nutrient intake, nutritional status and health conditions. A number of dietary factors are important protective factors for chronic diseases (including vegetable and fruit intake), whereas high intakes of fat (particularly saturated fat), sodium and total energy are risk factors.

Dietary habits were generally similar between Māori and non-Māori. Specifically, there were few differences between Māori and non-Māori in the frequency of eating fresh, frozen or canned fish and shellfish, and processed meat; the use of margarine as the preferred spread; and the use of iodised salt. However, there were some differences: Māori were less likely than non-Māori to eat breakfast daily, choose reduced fat or trim milk, trim fat off meat, remove the skin from chicken, and to never or rarely add salt to food. Māori females were three times more likely than non-Māori females to eat fast food three or more times a week and hot chips three or more times a week, and were 1.5 times more likely to drink soft drinks or energy drinks three or more times a week. Māori females were less likely to consume the recommended three servings of vegetables per day and two servings of fruit per day compared to non-Māori females.

From 1997 to 2008/09 there was an increase in the proportion of Māori males who consumed two or more servings of fruit a day but no change for Māori females. There was no change in the proportion of Māori males and females who consumed three or more servings of vegetables a day over the same time period.

Household food security

'Food security' is an internationally recognised term that encompasses the ready availability of nutritionally adequate and safe foods, and the assured ability to acquire personally acceptable foods in a socially acceptable way.

One-third of Māori live in a household classified as being *fully/almost food secure*, almost half in a household classified as being *moderately food secure*, and one in seven in a household classified as having *low food security*. Māori were more likely to live in households classified as having low and moderate food security and less likely to live in households classified as having full/almost full food security compared to non-Māori.

Between 1997 and 2008/09 there was an increase in the proportion of Māori living in households with low and moderate food security and a decrease in full / almost full food security.

Nutrition-related health outcomes

A range of anthropometric, biochemical and clinical measures were used to assess nutritional status and nutrition-related health outcomes in the 2008/09 NZANS.

Body size and obesity

Mean body mass index (BMI) was 29.9 kg/m^2 for Māori males and 30.7 kg/m^2 for Māori females. Māori males and females had a significantly higher mean BMI than non-Māori males and females. From 1997 to 2008/09 there was an increase in mean BMI in both Māori males and Māori females.

The prevalence of obesity was 40.7% in Māori males and 48.1% in Māori females; there was no significant change from 1997. Māori males and females were 1.5 and 2 times more likely to be obese compared to non-Māori males and females, respectively.

Blood pressure

High blood pressure is an important risk factor for heart disease, stroke and renal failure. Mean systolic blood pressure was 131 mmHg for Māori males and 120 mmHg for Māori females. Māori males and Māori females had a higher mean systolic and diastolic blood pressure than non-Māori males and non-Māori females.

Blood cholesterol

Blood cholesterol is an important risk factor for cardiovascular disease, particularly ischaemic heart disease. Mean total cholesterol was 5.17 mmol/L for Māori males and 4.81 mmol/L for Māori females. Māori females had a significantly lower mean total and HDL cholesterol level than non-Māori females. There has been a decrease in mean total cholesterol levels and an increase in mean HDL cholesterol levels for both Māori males and females from 1997 to 2008/09, resulting in an improved (decreased) total:HDL cholesterol ratio.

Diabetes and HbA1c

Glycated haemoglobin (HbA1c) was measured in blood samples to allow the prevalence of undiagnosed diabetes to be estimated and to measure diabetes control.

The overall prevalence of diabetes (combined diagnosed and undiagnosed) was 9.7% for Māori males and 9.8% for Māori females aged 15 years and over. The prevalence of undiagnosed diabetes was 2.0% for Māori males and 2.7% for Māori females, meaning 20–25% had not reported being told by a doctor that they had diabetes.

Māori females were nearly twice as likely to have diabetes (combined diagnosed and undiagnosed) as non-Māori females, after adjusting for age.

Among Māori adults with diagnosed diabetes, only 25.7% of males and 44.0% of females had good control of blood glucose levels (HbA1c < 7%). Māori males were significantly less likely to have good control than non-Māori males.

Folate status

Inadequate folic acid levels during pregnancy have been associated with an increased risk of neural tube defects (NTDs), a major group of birth defects in the developing fetus. Overall, 4.5% of Māori females of childbearing age (16–44 years) had red blood folate levels associated with having a high risk of having a baby with a neural tube defect. There was no difference in the proportions of Māori and non-Māori females who had a high risk of having a baby with neural tube defects.

Iodine status

Iodine is an essential component of thyroid hormones, which play a critical role in maintaining the body's metabolic rate and normal growth and mental development. Māori males and females are classified as mildly iodine deficient because the median urinary iodine concentration of 55 µg/L for Māori males and 57 µg/L for Māori females falls within the range defined by the International Council for the Control of Iodine Deficiency Disorders as mild iodine deficiency (50–99 µg/L). This survey took place before the implementation of mandatory fortification of bread with iodised salt (to reduce the prevalence of iodine deficiency) in September 2009.

1 Introduction

Background

This publication is a companion report to *A Focus on Nutrition: Key findings from the 2008/09 Adult Nutrition Survey* (University of Otago and Ministry of Health 2011a). It provides key findings on nutrition, nutrition-related health and food security for Māori from the 2008/09 New Zealand Adult Nutrition Survey (NZANS).

Findings for key indicators for energy and macronutrient intake, intake of selected vitamins and minerals, dietary habits, dietary supplement use, nutrition-related health and food security are presented for Māori. The report also looks at differences between Māori and non-Māori, as well as changes in selected indicators between 1997 and 2008/09, where possible.

A Focus on Pacific Nutrition is a further companion report that provides information on nutrition, nutrition-related health and food security for Pacific people.

All reports can be accessed at www.health.govt.nz/nz-health-statistics/national-collections-and-surveys/surveys/current-recent-surveys/nutrition-survey

How is this report different from *A Focus on Nutrition*?

A Focus on Nutrition: Key findings from the 2008/09 Adult Nutrition Survey (hereafter referred to as *A Focus on Nutritio*n) should be used to gain an overall picture of nutrition in the New Zealand population aged 15 years and over. That report includes unadjusted/crude results by ethnic group (New Zealand European & Other, Māori, Pacific). It should be used if you want information on the actual burden experienced by the ethnic group of interest, but do not use it to compare one ethnic group with another.

The focus of this current report is Māori, and all analyses refer to Māori. In this report, two mutually exclusive groups (Māori and non-Māori) are compared, taking into account differences by age. The use of total response standard output to define ethnicity in *A Focus on Nutrition* meant that it was not appropriate to include ethnic group comparisons in that report.

Overview of the survey

The 2008/09 NZANS was carried out from October 2008 to October 2009, collecting information from 4721 adult New Zealanders aged 15 years and over. The survey included 3374 New Zealand European/Other people, 1040 Māori and 757 Pacific people. The background and objectives of the survey are outlined in *A Focus on Nutrition*.

The 2008/09 NZANS collected information on dietary intake, dietary habits, dietary supplement use, food security, body size, blood pressure and nutrition-related health, including biochemical indices.

All results have been weighted in order to be representative of New Zealand's estimated resident population living in permanent private dwellings at 31 June 2007. The final weighted response rate for the 2008/09 NZANS was 61%. Because the number of respondents who gave blood and urine samples was lower, the final weighted response rates were calculated separately for the blood and urine samples, and they were both 44%.

It was not possible to calculate the overall response rate by demographic subgroups such as sex, ethnic group, age group and New Zealand Deprivation Index 2006[1] due to the unavailability of such information for some participants at the recruitment stage. However, partial response rates by demographic subgroups (including Māori) are presented in the *Methodology Report for the 2008/09 Adult Nutrition Survey* (University of Otago and Ministry of Health 2011b).

Methods

This section provides a brief overview of the methods relevant to this report. Full details of the methodology used for the 2008/009 NZANS can be found in the *Methodology Report for the 2008/09 Adult Nutrition Survey* (University of Otago and Ministry of Health 2011b).

The 2008/09 NZANS used a multi-stage, stratified, probability-proportional-to-size (PPS) sample design, with increased sampling of some ethnic groups and age groups. A three-step process was used to achieve the sample: a random sample of meshblocks, a sample of dwellings from within each meshblock, and selection of one eligible adult (aged 15 years and over, if any) from each selected dwelling. CBG Health Research Ltd recruited participants and the University of Otago collected data and conducted the recipe analysis and nutrient matching from the 24-hour diet recall.

Data were collected by face-to-face computer-assisted interviews and measurements in participants' homes. Firstly, a 24-hour diet recall was used to collect quantitative information on all foods and drinks consumed by the participant the previous day. Foods and beverages were matched to food composition data to calculate nutrient intake.

Secondly, respondents were asked questions about their dietary habits, use of dietary supplements, nutrition-related health and food security, and socio-demographic information was collected. Blood pressure, height, weight and waist circumference were then measured by the interviewers in the participant's home using professional equipment and standardised protocols. Each participant who gave informed consent to provide blood and urine samples was provided with a specimen collection kit, and the sample was collected at a Canterbury Health Laboratory affiliated laboratory in their area.

[1] The New Zealand Index of Deprivation 2006 is an area-based index of deprivation, which measures the level of socioeconomic deprivation for each neighbourhood (meshblock) according to a combination of the following 2006 Census variables: income, benefit receipt, transport (access to a car), household crowding, home ownership, employment status, qualifications, support (sole-parent families), and access to a telephone.

Ethnicity

Ethnicity is self-defined, and participants were able to report affiliation with up to nine different groups using the Statistics New Zealand standard ethnicity question. All survey participants reported affiliation with at least one ethnic group.

In this report, all participants who identified as Māori are included in the 'Māori' group; all other participants are included in the 'non-Māori' group. These two groups do not overlap.

A series of separate two-way comparisons are presented in this report, such that Māori are compared with non-Māori (the comparator group). It is important to note that the non-Māori comparator group should not be treated as a valid ethnic group in its own right, because it does not meet Statistics New Zealand's definition of an ethnic group. Therefore, the non-Māori group should not be the focus of analysis, but rather should be used as a statistical reference group (Statistics New Zealand 2005).

Analysis

For Māori, crude data are presented for means, medians and proportions, with 95% confidence intervals. Crude (or unadjusted) data are data that have not been adjusted for other factors (such as age). Crude data are used to show the burden of a particular indicator on a population group.

Crude data are not presented for non-Māori because this is not a recognised ethnic group. Instead, where comparisons between Māori and non-Māori are made, age-standardised ratios and differences are presented. Age standardisation was performed by the direct method using the World Health Organization (WHO) world population age distribution (Ahmad et al 2000), which takes into account any differences in the age distribution of two populations.

Ratios give a measure of relative difference in burden for the group of interest, while differences give a measure of the absolute difference in burden. Ratios and differences complement each other and give different perspectives on the difference between two groups with respect to the outcome measure. For example, a 20% difference (eg, Māori = 40%, non-Māori = 20%, difference = 40% – 20% = 20%) can be interpreted as placing a much higher burden on the group than a 1% difference (eg, Māori = 2%, non-Māori = 1%, difference = 1%), even though in both examples Māori have twice the risk as non-Māori (ie, the same ratio of 2). Ratios and differences are explained in more detail below.

Ratios

In this document, a ratio is a ratio of estimates for two populations. The estimate can be a proportion (prevalence), mean or median.

$$\text{Ratio} = \frac{\text{prevalence (or mean or median) in Māori}}{\text{prevalence (or mean or median) in non-Māori}}$$

Ratios (and ratios of means) can be interpreted in the following ways.

- A value of 1.00 shows that there is no difference between Māori and non-Māori.
- A value higher than 1.00 means that the result is higher for Māori than non-Māori.
- A value lower than 1.00 means that the result is lower for Māori than non-Māori.
- Values that have an asterisk (*) are statistically significant.

All the comparisons in this report refer to Māori as the 'group of interest' compared with non-Māori as the 'reference group'. Conversely, to obtain the ratio for the reference group (non-Māori) compared to the group of interest (Māori), divide 1 by the ratio.

Differences

The difference is a measure of the difference between estimates for Māori and non-Māori.

$$\text{Difference} = (\text{prevalence or mean or median in Māori}) - (\text{prevalence or mean or median in non-Māori})$$

It should be noted that in a few cases, for a particular comparison, the difference is statistically significant at the 5% level (noted with an asterisk) while the ratio is not statistically significant. This may occur when both the difference and the ratio are close to the cut-off of statistical significance (ie, close to a p-value of 0.05).

Statistical significance and 95% confidence intervals

In this report, information about statistical significance is given as either 95% confidence intervals (for means, medians and proportions) or as asterisks (for ratios and differences) noting statistical significance at the 5% level of significance (p-value < 0.05).

Ninety-five percent confidence intervals represent the sample error for estimates. A 95% confidence interval means there is a 95% chance that the true value of the estimate (if we were to survey the whole population) lies between the lower and upper confidence interval values.

Only statistically significant differences have been discussed in the text. However, if there was no statistically significant difference between subgroups, this does not necessarily mean there was no difference; it could be that the sample size was too small to detect a significant difference at the 95% level based on non-overlapping confidence intervals.

Age standardisation

In this report, ratios and differences were adjusted for possible confounding factors, to make comparisons more accurate and meaningful. The Māori population is generally younger than the total New Zealand population, and therefore it is important to adjust for age when comparing Māori and non-Māori. In this report, age standardisation was performed by the direct method using the WHO world population age distribution (Ahmad et al 2000).

Usual intake distributions

Using a repeat 24-hour diet recall from a subsample (25%) of participants, nutrient intakes for each subgroup were adjusted for intra-individual variability using the PC-SIDE programme to obtain usual intake distributions. Nutrient ratios (eg, percent energy from protein) were not adjusted for intra-individual variation because the only methods that have been developed for ratios use multiple-day repeats.

Accuracy of energy and nutrient intake estimates

The accuracy of nutrient estimates depends on two factors: the accuracy of information provided by participants in the 24-hour diet recall and the accuracy of the food composition data. Misreporting of a food intake, especially under-reporting, is a well-known problem in all types of dietary surveys. If food intake is under-reported, energy and nutrient intakes will be underestimated. For more information on potential sources of error, see the *Methodology Report* (University of Otago and Ministry of Health 2011b).

Nutrient adequacy

For selected nutrients, the probability of inadequate intake was estimated by comparing the *usual* intake distribution to the estimated average requirement (EAR) from the nutrient reference values (NRVs) for Australia and New Zealand (NHMRC 2006). Nutrient adequacy could not be determined if there was no EAR for a nutrient.

When interpreting the prevalence of inadequate intakes it is important to note the following.

- Nutrient intake estimates are from food and drinks only and exclude intake from dietary supplements (other than supplements providing energy, such as meal replacements).
- Nutrient intake estimates depend on the accuracy of the information provided by participants in the 24-hour diet recall and the accuracy of the food composition data.

- The prevalence of inadequate intakes partly reflects the criterion on which the requirement is based. A cautionary comment on the interpretation of adequacy of intake for a nutrient has been made when the derivation of the reference value is either unclear or scientifically debatable.
- Accurate assessment of nutritional status requires a combination of dietary, anthropometric, biochemical and clinical measurements (Gibson 2005). Adequacy or inadequacy of nutritional status cannot be determined from dietary data alone.

Given these potential sources of error in the estimation of inadequate intake, and the smaller sample size for Māori (resulting in large standard errors and wide confidence intervals), comparisons of nutrient adequacy between Māori and non-Māori are not presented in this report.

Sex differences

Males have a higher body weight and a greater proportion of lean body mass than females. They therefore require more food (energy) to maintain their body mass and to meet their requirements for physical activity and basal metabolic rate. Therefore, daily energy intake, on average, for males is expected to exceed that for females, as will their intake of macronutrients.

Time trends

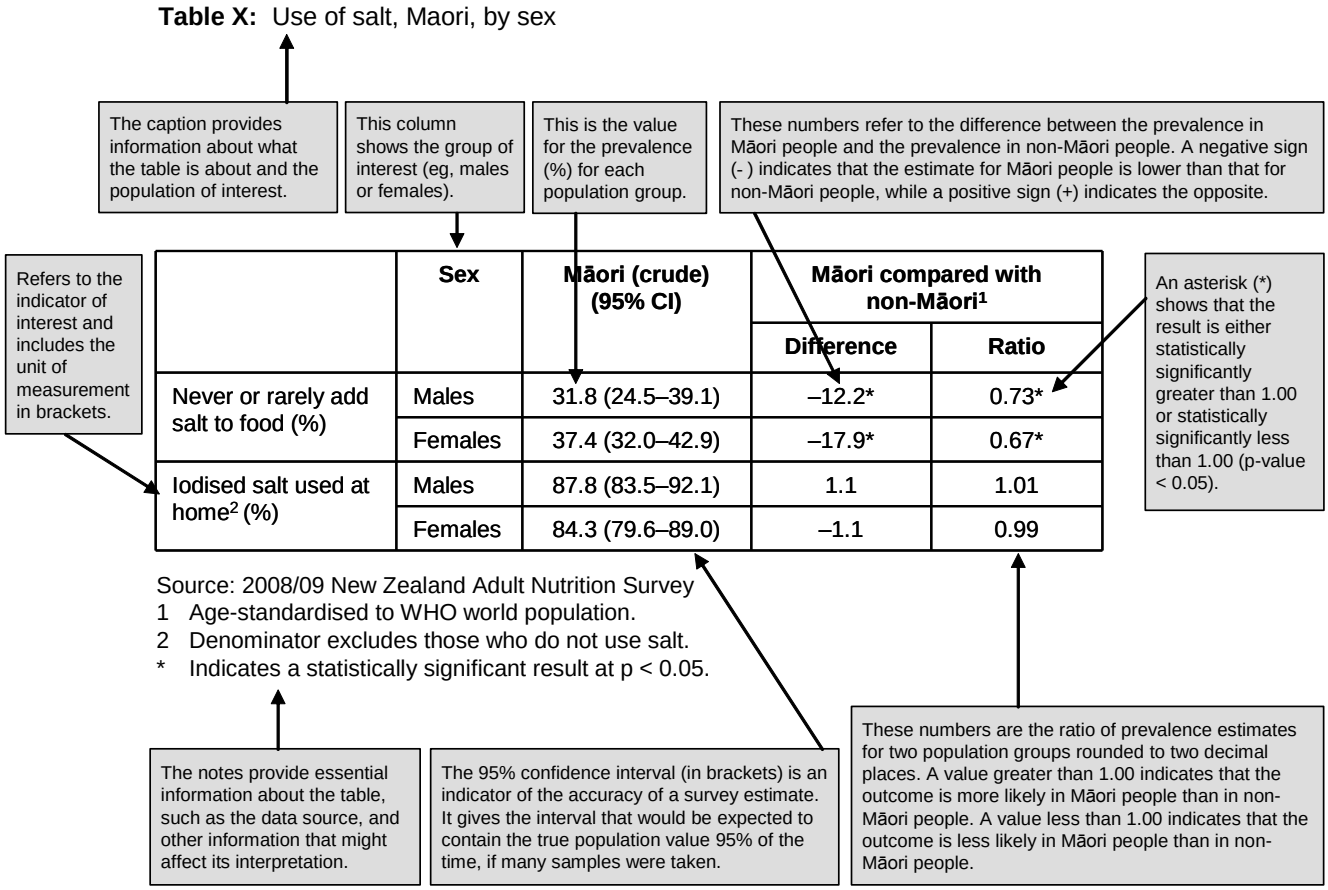
Where possible, comparisons between the 2008/09 NZANS and the 1997 National Nutrition Survey (NNS) have been reported. Time trend analyses were restricted to nutrition indicators that were considered comparable across surveys. Because the age structure of the New Zealand population has changed since 1997, age-standardised data are presented in the time-trend tables. Age-standardised ratios were used to compare the 1997 and 2008/09 surveys.

The ratios presented in the time trend sections can be interpreted in the following ways:

- A value of 1.00 shows that there is no difference between 1997 and 2008/09.
- A value higher than 1.00 means that there has been an increase in the indicator between 1997 and 2008/09.
- A value lower than 1.00 means that there has been a decrease in the indicator between 1997 and 2008/09.
- Values that have an arrow (↑ or ↓) indicate a statistically significant (p-value < 0.05) increase or decrease between 1997 and 2008/09.

How to interpret tables in this report

The following diagram shows how to interpret the tables of comparisons presented in this report. Further information on how to interpret differences and ratios is available on page 4.



2 Energy and macronutrient intake

New Zealanders obtain the energy and nutrients they require from a wide variety of foods and beverages, and in some cases from dietary supplements as well. This chapter on energy and macronutrients presents the intake of energy and nutrients from food and beverages, without adding the nutrients from supplements (other than supplements providing energy, such as meal replacements).

Energy

Energy is required in the body for metabolic processes, physiological functions, muscular activity, heat production, growth and the synthesis of new tissues. Food components release energy through oxidation during the digestive process. Protein, carbohydrate, fat and alcohol (the macronutrients) from food and drinks are the only sources of energy for humans. Energy requirements can vary widely according to sex, body size and physical activity (NHMRC 2006).

The median usual daily energy intake was 11,449 kJ for Māori males and 7632 kJ for Māori females (Table 2.1). Māori males had a significantly higher median usual daily energy intake than non-Māori males, after adjusting for age. There was no difference in the median usual daily energy intake between Māori and non-Māori females, after adjusting for age.

Percent energy from macronutrients

Percent energy from macronutrients per day was calculated from day 1 of recall as follows (NHMRC 2006):

- percent energy from fat = (fat [g/day] x 37.7 kJ/g) / energy (kJ/day)
- percent energy from carbohydrate = (carbohydrate [g/day] x 16.7 kJ/g) / energy (kJ/day)
- percent energy from protein = (protein [g/day] x 16.7 kJ/g) / energy (kJ/day).

Protein

The acceptable macronutrient distribution range for protein intake is 15% to 25% of energy (NHMRC 2006). Māori males and females consumed 16.8% and 16.3% of energy from protein, respectively (Table 2.1). There were no significant differences between Māori and non-Māori males and females, respectively, in the contribution to energy from protein, after adjusting for age.

Fat

The acceptable macronutrient distribution range for total fat intake is 20% to 35% of total daily energy intake (NHMRC 2006). In addition, to reduce chronic disease, saturated fats and trans fats together should be limited to no more than 10% of energy (NHMRC 2006).

Māori males consumed 36.6% of energy from total fat and Māori females consumed 35.6% of energy from fat (Table 2.1). Māori males consumed 14.5% of energy from saturated fat, 13.6% of energy from monounsaturated fat and 4.9% of energy from polyunsaturated fat. Māori females consumed 14.2% of energy from saturated fat, 13.0% of energy from monounsaturated fat and 4.7% of energy from polyunsaturated fat.

Māori males and females consumed a higher mean percentage of energy from total fat, saturated fat and monounsaturated fat than non-Māori males and females, after adjusting for age.

Carbohydrate

The acceptable macronutrient distribution range for carbohydrate intake is 45% to 65% of energy (NHMRC 2006). Māori males and Māori females consumed 43.9% and 46.6% of energy from carbohydrate, respectively. Māori males consumed significantly less energy from carbohydrate than non-Māori males, after adjusting for age (Table 2.1). There was no significant difference between Māori and non-Māori females in the contribution to energy from carbohydrate, after adjusting for age.

Dietary fibre

The median usual daily intake of dietary fibre was 21.5 g for Māori males and 16.2 g for Māori females (Table 2.1). There were no significant differences in the median intakes of fibre between Māori and non-Māori males and females, respectively, after adjusting for age.

Table 2.1: Median energy and macronutrient intake, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Energy – median intake (kJ)	Males	11,449 (10,839–12,059)	1248*	1.12*
	Females	7632 (7285–7979)	191	1.03
Protein – mean percent of total energy	Males	16.8 (16.1–17.5)	0.6	1.03
	Females	16.3 (15.8–16.7)	0	1.00
Fat – mean percent of total energy	Males	36.6 (35.5–37.7)	3.2*	1.09*
	Females	35.6 (34.6–36.5)	2.1*	1.06*
Saturated fat – mean percent of total energy	Males	14.5 (13.9–15.0)	1.4*	1.10*
	Females	14.2 (13.7–14.7)	1.2*	1.09*
Monounsaturated fat – mean percent of total energy	Males	13.6 (13.1–14.2)	1.3*	1.10*
	Females	13.0 (12.5–13.4)	0.7*	1.06*
Polyunsaturated fat – mean percent of total energy	Males	4.9 (4.6–5.1)	0.2	1.04
	Females	4.7 (4.5–4.9)	–0.1	0.98
Carbohydrate – mean percent of total energy	Males	43.9 (42.7–45.2)	–2.5*	0.95*
	Females	46.6 (45.5–47.7)	–0.9	0.98
Dietary fibre – median intake (g)	Males	21.5 (20.3–22.7)	–1.2	0.95
	Females	16.2 (15.0–17.4)	–1.9	0.91

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Time trends in energy and macronutrient intake

From 1997 to 2008/09 the median energy intake did not change for Māori males, and decreased for Māori females. From 1997 to 2008/09 the contribution of total fat, protein and carbohydrate to energy in the diet did not change for Māori males or females, after adjusting for age (Table 2.2). The proportion of energy from saturated fat decreased for both Māori males (15.4% to 14.5%) and Māori females (15.6% to 14.2%), although this decrease was only significant for females. The proportion of energy from monounsaturated fat increased for both Māori males (12.8% to 13.7%) and females (11.9% to 13.0%), after adjusting for age.

Table 2.2: Median energy and contribution of macronutrients to daily energy, Māori, by sex,[1] 1997 and 2008/09

	Sex	1997 (95% CI)	2008/09 (95% CI)	Ratio	Trend for non-Māori
Energy – median intake (kJ)	Males	11,758 (10,066–13,449)	11,080 (10,472–11,688)	0.94	↓
	Females	8543 (7808–9278)	7507 (7162–7852)	0.88↓	nc
Protein – percent of total energy	Males	16.3 (15.2–17.4)	16.9 (16.3–17.5)	1.04	↑
	Females	15.6 (15.0–16.2)	16.3 (15.8–16.7)	1.04	nc
Fat – percent of total energy	Males	36.9 (35.3–38.5)	36.8 (35.8–37.8)	1.00	↓
	Females	36.3 (34.9–37.7)	35.6 (34.6–36.5)	0.98	nc
Saturated fat – percent of total energy	Males	15.4 (14.5–16.3)	14.5 (13.9–15.0)	0.94	↓
	Females	15.6 (14.8–16.4)	14.2 (13.7–14.7)	0.91↓	↓
Monounsaturated fat – percent of total energy	Males	12.8 (12.2–13.4)	13.7 (13.2–14.3)	1.07↑	↑
	Females	11.9 (11.3–12.5)	13.0 (12.5–13.4)	1.09↑	↑
Polyunsaturated fat – percent of total energy	Males	5.0 (4.5–5.5)	4.9 (4.7–5.2)	0.98	nc
	Females	5.0 (4.6–5.5)	4.8 (4.5–5.0)	0.95	nc
Carbohydrate – percent of total energy	Males	42.3 (40.2–44.3)	43.8 (42.6–45.0)	1.04	nc
	Females	46.4 (44.9–47.8)	46.7 (45.5–47.8)	1.01	nc

Sources: 1997 National Nutrition Survey; 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

↑ Statistically significant increase from 1997 to 2008/09 at p-value < 0.05.

↓ Statistically significant decrease from 1997 to 2008/09 at p-value < 0.05.

nc No change from 1997 to 2008/09 at p-value < 0.05.

3 Micronutrient intake

This chapter on selected vitamins and minerals presents the intake of nutrients from food and beverages, without adding the nutrients from supplements (other than supplements providing energy, such as meal replacements).

Vitamins

Vitamin A

'Vitamin A' is a generic term which describes retinol and related structures and the pro-vitamin A carotenoids. The activity of retinol is described by retinol equivalents (RE), whereby 1 µg RE is equivalent to 1 µg of retinol, 6 µg of β-carotene or 12 µg of other carotenoids (Mann and Truswell 2007).

Vitamin A is required for vision, immune function, regulation of cell growth and normal reproduction (Mann and Truswell 2007). Animal foods such as liver, milk, butter, cheese, egg yolk, some fatty fish and table margarine (which is usually fortified with vitamin A to a similar level to that found in butter) provide retinol. The pro-vitamin A carotenoids come from plant foods such as dark-green leafy vegetables and some yellow or orange-coloured fruits and vegetables (Mann and Truswell 2007; Rolfes et al 2009).

Māori males and females had a median usual daily intake of vitamin A of 939 µg RE and 710 µg RE respectively (Table 3.1). There were no significant differences in the median usual daily intake of vitamin A between Māori and non-Māori males and females, respectively, after adjusting for age.

The estimated prevalence of inadequate intake of vitamin A RE for Māori was 17.8% for males and 16.6% for females.

Riboflavin

Riboflavin is involved in energy metabolism. The best sources are milk and milk products (Rolfes et al 2009). Māori males and females had a median usual daily intake of riboflavin of 2.2 mg and 1.7 mg, respectively (Table 3.1). There were no significant differences in the median usual daily intake of riboflavin between Māori and non-Māori males and females, respectively, after adjusting for age.

The estimated prevalence of inadequate intake of riboflavin for Māori was 3.8% for males and 5.4% for females.

Vitamin B_{12}

Adequate intake of vitamin B_{12} is essential for normal blood and neurological function (NHMRC 2006). Vitamin B_{12} is found almost exclusively in foods derived from animals. Māori males and females had a median usual daily intake of vitamin B_{12} of 5.5 mg and 3.8 mg, respectively (Table 3.1). There was no significant difference in the median usual daily intake of vitamin B_{12} between Māori and non-Māori after adjusting for age.

The estimated prevalence of inadequate intake of vitamin B_{12} for Māori was 5.1% for males and 12.4% for females.

Table 3.1: Median usual daily intake of selected vitamins, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Vitamin A (µg RE)	Males	939 (792–1086)	114	1.14
	Females	710 (631–789)	–15	0.98
Riboflavin (mg)	Males	2.2 (2.0–2.3)	0	0.99
	Females	1.7 (1.5–1.8)	0	0.99
Vitamin B_{12} (mg)	Males	5.5 (4.6–6.4)	0.7	1.15
	Females	3.8 (3.3–4.4)	0.5	1.15

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

Minerals

Calcium

Calcium is required for the normal development and maintenance of the skeleton. Calcium also plays an essential role in regulating muscle contraction, nerve conductivity, blood clotting and many other important bodily functions (Mann and Truswell 2007; Rolfes et al 2009).

Milk and some milk products (eg, yoghurt and cheese) are good sources of calcium. Non-dairy sources of calcium include tinned fish (with bones), green leafy vegetables, nuts and seeds, and fortified soy and rice milk.

Māori males and females had a median usual daily intake of calcium of 863 mg and 711 mg, respectively (Table 3.2). There were no significant differences in the median usual daily intake of calcium between Māori and non-Māori males and females, respectively, after adjusting for age.

The estimated prevalence of inadequate intake of calcium for Māori was 53.3% for males and 71.4% for females. These data should be interpreted cautiously, however, because the EAR values have been augmented by 320 mg to take into account 'unspecified low absorption that occurs at about 500 mg/day' (NHMRC 2006). While calcium is of major importance for attaining and maintaining bone health, other factors such as vitamin D intakes, exercise levels and habitual levels of intake all influence bone health.

Zinc

Zinc is essential for many functions, including protein synthesis, insulin synthesis and action, growth, immune function, wound healing, transport of vitamin A, taste perception, appetite and reproduction (Mann and Truswell 2007; Rolfes et al 2009).

Zinc is widely available in the food supply, but it is more bioavailable from animal products than from plant foods. Rich sources include oysters, red meat, lamb's liver and cheese (Mann and Truswell 2007). Cereal grains, legumes and nuts are also rich sources of zinc, but they also are high in phytates, which reduce zinc absorption (Mann and Truswell 2007).

Māori males and females had a median usual daily intake of zinc of 13.3 mg and 9.1 mg, respectively (Table 3.2). There were no significant differences in the median usual daily intake of zinc between Māori and non-Māori males and females, respectively, after adjusting for age.

The estimated prevalence of inadequate intake of zinc for Māori was 34.3% for males and 14.7% for females.

Selenium

Selenium is involved in a range of processes, including thyroid hormone metabolism, immune function, reproduction and antioxidant defence (Mann and Truswell 2007).

The selenium content of plant foods is dependent on the selenium content of the soils in which they are grown. Fruit, vegetables and grains grown in New Zealand tend to have lower selenium levels than plant foods from countries where the soil selenium concentrations are higher. The selenium content of animal foods is less variable than that of plant foods.

Māori males and females had a median usual daily intake of selenium of 81.0 µg and 51.0 µg, respectively. There was no significant difference in median usual daily intake between Māori and non-Māori females. However, Māori males had a significantly higher median usual daily intake of selenium than non-Māori males, after adjusting for age.

The estimated prevalence of inadequate intake of selenium for Māori was 31.5% for males and 53.3% for females.

Table 3.2: Median daily usual intake of selected minerals, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Calcium (mg)	Males	863 (769–957)	–49	0.95
	Females	711 (662–760)	–41	0.95
Zinc (mg)	Males	13.3 (12.4–14.2)	0.5	1.04
	Females	9.1 (8.6–9.6)	0	1.00
Selenium (µg)	Males	81.0 (69.9–92.1)	18.0*	1.28*
	Females	51.0 (45.0–57.0)	5.2	1.11

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

4 Dietary supplements

Dietary supplements are products the participant considered or intended 'as a supplement to their diet'. In the survey, participants were asked if they had taken any dietary supplements at any time during the last 12 months. Regular dietary supplement users were those who had consumed at least one supplement at least once a week. Occasional dietary supplement users were those who had consumed fewer than one supplement a week during the last 12 months.

Overall, 31.4% of Māori males and 38.2% of Māori females had consumed a dietary supplement at any time in the past 12 months (Table 4.1). Of those who used supplements, over half consumed dietary supplements regularly.

Māori males and females were significantly less likely to have taken dietary supplements in the past 12 months than non-Māori males and females, after adjusting for age. Among those who used dietary supplements in the past year, there were no significant differences between Māori and non-Māori males and females, respectively, in the regular or occasional use of dietary supplements, after adjusting for age.

Table 4.1: Dietary supplement use in the past 12 months, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Any time in past 12 months[2] (%)	Males	31.4 (25.1–37.7)	–10.2*	0.77*
	Females	38.2 (33.1–43.2)	–18.1*	0.67*
Regularly[3] (%)	Males	55.2 (40.1–70.3)	–1.7	0.97
	Females	56.9 (46.2–67.6)	–8.6	0.87
Occasionally[4] (%)	Males	44.8 (29.7–59.9)	1.7	1.04
	Females	43.1 (32.4–53.8)	8.6	1.25

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

2 Any consumption over the past 12 months.

3 At least one supplement consumed daily, more than once per week or once per week, among those who consumed a supplement any time in the past 12 months.

4 Any consumption less than once per week among those who consumed a supplement any time in the past 12 months.

* Indicates a statistically significant result at p-value < 0.05.

5 Dietary habits

The 2008/09 NZANS included a series of questions on key dietary patterns or habits associated with diet quality and/or nutritional status. Participants were asked about the frequency of eating certain foods, the type of food eaten and the frequency of certain food preparation or cooking practices.

Consumption of breakfast

Eating breakfast regularly is associated with better nutrient intake, the prevention of weight gain and a lower body mass index (BMI) compared with skipping breakfast (Cho et al 2003; Ma et al 2003; van der Heijden et al 2007). Survey participants were asked how many days in an average week they have something to eat for breakfast (at home, in a car, at work or in a café).

About half of Māori males and females ate breakfast daily (Table 5.1). Just under one-quarter ate breakfast 3–6 days per week and just over one-quarter ate breakfast 2 or less days a week. Māori males and females were less likely to eat breakfast daily than non-Māori, after adjusting for age.

Table 5.1: Consumption of breakfast, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Breakfast eaten daily (%)	Males	48.6 (42.1–55.1)	–11.3*	0.82*
	Females	48.4 (43.7–53.2)	–17.3*	0.74*
Breakfast eaten 3–6 days per week (%)	Males	27.2 (20.8–33.7)	5.0	1.23
	Females	28.4 (24.6–32.3)	8.6*	1.44*
Breakfast eaten 0–2 days per week (%)	Males	24.2 (18.9–29.4)	6.2*	1.38
	Females	23.1 (19.0–27.2)	8.7*	1.65*

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Vegetable and fruit intake

The Ministry of Health recommends that adults eat at least three servings of vegetables and at least two servings of fruit each day (Ministry of Health 2003).

In the survey, participants were asked how many servings of vegetables (fresh, frozen or canned) were eaten a day on average. They were asked not to include vegetable juices. A serving was defined as being the same as one potato, half a cup of peas or a cup of salad.

Participants were also asked how many servings of fruit (fresh, frozen, canned or stewed) were eaten a day, on average. They were asked not to include fruit juice or dried fruit. A serving was defined as being the same as a medium piece of fruit like an apple, or two small pieces of fruit like two apricots, or half a cup of stewed fruit. Note that the Ministry of Health recommendation allows up to one serving of juice to be consumed, whereas the survey question excluded juice.

Over half of Māori participants had met the recommended guideline of eating three or more servings of vegetables a day and two or more servings of fruit a day (Table 5.2). Māori females were significantly less likely to meet either of the vegetable and fruit guidelines than non-Māori females, adjusting for age. There was no difference in the proportion of Māori and non-Māori males meeting either of the guidelines, after adjusting for age.

Table 5.2: Vegetable and fruit intake, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
3 or more servings of vegetables per day (%)	Males	51.8 (45.0–58.5)	–5.9	0.90
	Females	59.1 (53.3–65.0)	–11.8*	0.83*
2 or more servings of fruit per day (%)	Males	50.4 (43.9–56.9)	–3.4	0.94
	Females	56.9 (51.7–62.0)	–9.0*	0.86*

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Time trends in vegetable and fruit intake

There was no change from 1997 to 2008/09 in the proportion of Māori males and females consuming the recommended three or more servings of vegetables a day, after adjusting for age (Table 5.3). From 1997 to 2008/09 there was an increase in the proportion of Māori males who consumed the recommended two or more servings of fruit a day, but no change for Māori females.

Table 5.3: Vegetable and fruit intake, Māori, by sex,[1] 1997 and 2008/09

	Sex	1997 (95% CI)	2008/09 (95% CI)	Ratio	Trend for non-Māori
3 or more servings of vegetables per day (%)	Males	50.4 (41.2–59.7)	52.1 (45.2–59.1)	1.03	nc
	Females	65.1 (58.7–71.6)	59.2 (53.4–65.1)	0.91	nc
2 or more servings of fruit per day (%)	Males	30.7 (21.5–39.9)	50.6 (43.8–57.5)	1.65↑	↑
	Females	50.1 (41.8–58.3)	56.8 (51.8–61.9)	1.14	↑

Source: 1997 National Nutrition Survey, 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

↑ Statistically significant increase from 1997 to 2008/09 at p-value < 0.05.

Consumption of bread

The *Food and Nutrition Guidelines for Healthy Adults* (Ministry of Health 2003) recommend that adults eat at least six servings of breads and cereals each day, preferably whole-grain varieties. In the survey, participants were asked what type of bread, rolls or toast they eat most of. Response options included white, high-fibre white, light grain, heavy grain, and other types of bread.

Among those who eat bread, grain bread (light or heavy) and white bread were the types selected most of the time by both Māori males and females; about half selected grain bread (light or heavy) most often, and just under half selected white bread most often (Table 5.4).

Among those who eat bread, Māori females were significantly less likely to eat mostly grain bread (light or heavy) than non-Māori females. Māori males were 1.3 times more likely and Māori females 1.9 times more likely to eat mostly white bread than non-Māori (Table 5.4), after adjusting for age.

Table 5.4: Type of bread selected most of the time among those who eat bread, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Light grain or heavy grain (%)	Males	51.6 (44.9–58.3)	–6.2	0.90
	Females	48.6 (43.2–53.9)	–17.4*	0.74*
High-fibre white bread (%)	Males	3.8 (1.6–7.3)	–1.4	0.73
	Females	2.3 (1.2–3.9)	–2.1	0.56*
White bread (%)	Males	43.1 (36.9–49.3)	8.6*	1.26*
	Females	47.4 (42.1–52.7)	21.4*	1.85*
Other (%)	Males	1.0 (0.4–2.2)	–1.3	0.47*
	Females	1.4 (0.5–3.1)	–2.0*	0.43*

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Consumption of milk

The *Food and Nutrition Guidelines for Healthy Adults* (Ministry of Health 2003) recommend that adults choose low- or reduced-fat options for milk and milk products. In the survey, participants were asked the type of milk they consumed most often. Response options included whole or standard milk, reduced fat, skim or trim, soy, and other types of milk. Respondents were also able to indicate if they didn't drink milk.

One-quarter of Māori males and over one-third of Māori females used reduced fat, trim or skim milk most of the time (Table 5.5). Seventy percent of Māori males and 58% of Māori females used whole or standard milk most of the time. Only a small proportion of Māori males and females consumed soy milk. Māori males and females were more likely to use mostly whole or standard milk and less likely to used reduced fat, trim or skim milk than non-Māori males and females, respectively, after adjusting for age.

Table 5.5: Type of milk[2] selected most of the time, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Reduced fat, trim or skim milk (%)	Males	24.3 (18.9–29.6)	–21.4*	0.53*
	Females	35.5 (29.9–41.0)	–17.3*	0.67*
Whole or standard milk (%)	Males	70.2 (64.7–75.7)	22.1*	1.46*
	Females	58.3 (52.4–64.2)	20.8*	1.55*
Soy (%)	Males	0.8 (0.0–3.7)	–0.6	0.57
	Females	3.5 (1.9–5.8)	0.1	1.02
None (%)	Males	4.6 (1.8–9.7)	0.8	1.17
	Females	2.4 (1.3–4.1)	–2.6*	0.48*

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

2 Other milk = 0.2% males and 0.4% females, so not included in table.

* Indicates a statistically significant result at p-value < 0.05.

Consumption of fish and shellfish

Survey participants were asked if they had eaten fish or shellfish in the past four weeks, and if so, how often they ate fresh and frozen fish or shellfish; canned fish or shellfish; and battered fish or shellfish.

Fresh and frozen fish or shellfish

About one in three Māori males (36.6%) and females (36.2%) ate fresh or frozen fish or shellfish at least once a week (Table 5.6). There was no significant difference in the frequency of eating fish between Māori and non-Māori males and females, respectively, after adjusting for age.

Table 5.6: Frequency of eating fresh or frozen fish or shellfish, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Eats fresh or frozen fish or shellfish at least once a week (%)	Males	36.6 (30.3–42.9)	–2.0	0.95
	Females	36.2 (30.4–41.9)	–3.9	0.90
Eats fresh or frozen fish or shellfish less than once a week (%)	Males	28.2 (23.4–32.9)	–2.7	0.91
	Females	28.9 (23.8–34.0)	–0.6	0.98
Never, or have not consumed fresh or frozen fish or shellfish in the past 4 weeks (%)	Males	35.2 (28.8–41.6)	4.7	1.16
	Females	34.9 (30.5–39.4)	4.4	1.15

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

Canned fish or shellfish

Twenty-one percent of Māori males and 25.8% of Māori females ate canned fish or shellfish at least once a week (Table 5.7). Māori males were less likely to eat canned fish or shellfish at least once a week than non-Māori males, after adjusting for age. There was no difference in the frequency of eating canned fish between Māori and non-Māori females, after adjusting for age.

Table 5.7: Frequency of eating canned fish or shellfish, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Eats canned fish or shellfish at least once a week (%)	Males	21.0 (16.5–25.5)	–5.6*	0.79*
	Females	25.8 (20.4–31.2)	–3.6	0.88
Eats canned fish or shellfish less than once a week (%)	Males	25.9 (19.6–32.3)	–0.2	0.99
	Females	28.9 (23.3–34.5)	0.3	1.01
Never, or have not consumed canned fish or shellfish in the past 4 weeks (%)	Males	53.1 (47.0–59.1)	5.8	1.13
	Females	45.3 (39.3–51.3)	3.3	1.08

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Battered or fried fish or shellfish

Overall, 29.2% of Māori males and 24.5% of Māori females ate battered or fried fish or shellfish at least once a week (Table 5.8). Māori males and females were 1.5 times and 2.3 times more likely to eat battered fish or shellfish at least once a week than non-Māori males and females respectively, after adjusting for age.

Table 5.8: Frequency of eating battered or fried fish or shellfish, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Eats battered or fried fish or shellfish at least once a week (%)	Males	29.2 (22.8–35.7)	9.0*	1.46*
	Females	24.5 (20.3–28.6)	14.3*	2.33*
Eats battered or fried fish or shellfish less than once a week (%)	Males	36.7 (31.6–41.8)	–4.7	0.89
	Females	36.9 (31.1–42.7)	–7.1	0.84
Never, or have not consumed battered or fried fish or shellfish in the past 4 weeks (%)	Males	34.1 (28.5–39.7)	–4.3	0.89
	Females	38.6 (33.6–43.6)	–7.2*	0.84*

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Consumption of processed meat

The World Cancer Research Fund and American Institute for Cancer Research (2007) recommend avoiding processed meat due to convincing evidence that as more processed meat is consumed there is an increased risk of colorectal cancer. Processed meat is also likely to be relatively high in saturated fat and sodium, which are also risk factors for a number of chronic diseases. Survey participants were asked how often they consumed processed meats such as ham, bacon, sausages, luncheon, canned corned beef, pastrami and salami.

Overall, 45.2% of Māori males and 26.7% of Māori females ate processed meat three or more times per week (Table 5.9). There was no difference in the proportion of Māori and non-Māori males and females, respectively, consuming processed meat three or more times a week or one to two times a week, after adjusting for age. Māori males and females were less likely to have consumed processed meat never, or less than once a week, than non-Māori males and females, respectively, after adjusting for age.

Table 5.9: Frequency of eating processed meat, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Eats processed meat 3 or more times a week (%)	Males	45.2 (38.6–51.9)	6.8	1.19
	Females	26.7 (21.9–31.5)	2.5	1.11
Eats processed meat 1–2 times a week (%)	Males	39.8 (33.1–46.5)	0.2	1.00
	Females	44.2 (38.7–49.8)	3.9	1.09
Eats processed meat less than 1 time a week / never eats processed meat (%)	Males	14.9 (10.8–19.1)	–7.0*	0.70*
	Females	29.0 (24.1–34.0)	–6.4*	0.82*

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Consumption of butter and margarine

The *Food and Nutrition Guidelines for Healthy Adults* (Ministry of Health 2003) recommend choosing a margarine or spread (polyunsaturated or monounsaturated) instead of butter. Survey participants were asked what type of butter or margarine spread they used the most of. Response options included butter, butter and margarine blend, margarine (full-fat), light/lite or reduced-fat margarine, plant sterol margarine, and no spread used.

The majority of Māori males and females use full-fat or light margarine as a spread, with a smaller proportion using butter (Table 5.10). Māori males and females were more likely to choose full-fat margarine and less likely to use light/lite or reduced-fat margarine or plant sterol margarine as a spread most of the time than non-Māori males and females, respectively, after adjusting for age. There was no difference in the proportion of Māori and non-Māori males and females, respectively, in the choice of butter or butter/margarine blend as a spread most of the time, after adjusting for age.

Table 5.10: Type of spread used most of the time, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Butter (%)	Males	25.0 (18.8–31.2)	5.1	1.26
	Females	18.7 (14.5–22.8)	–1.3	0.94
Butter/margarine blend (%)	Males	5.7 (3.1–9.5)	1.9	1.57
	Females	2.7 (1.5–4.6)	–0.8	0.76
Full-fat margarine (%)	Males	46.7 (40.3–53.2)	10.6*	1.29*
	Females	50.2 (44.5–56.0)	17.4*	1.53*
Light/lite or reduced-fat margarine (%)	Males	18.2 (12.0–24.4)	–9.0*	0.67*
	Females	23.6 (17.9–29.2)	–7.1*	0.77*
Plant sterol margarine (%)	Males	1.5 (0.4–3.8)	–2.5*	0.39*
	Females	0.4 (0.1–1.3)	–3.8*	0.10*
No spread used (%)	Males	2.8 (1.4–5.1)	–6.1*	0.33*
	Females	4.4 (1.9–8.5)	–4.2*	0.50*

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Use of cooking fat

The *Food and Nutrition Guidelines* (Ministry of Health 2003) recommend using vegetable oil or oil high in monounsaturated fat for cooking. Survey participants were also asked what type of fat or oil they used most often when cooking. Response options included butter, butter-blend, margarine, oil, dripping or lard, other type of fat or oil, and no fat or oil used.

The majority of Māori males and females chose cooking oil or margarine for cooking most of the time (Table 5.11) rather than butter, butter-blend, dripping or lard. Māori males were more likely than non-Māori males to use butter, butter-blend, dripping or lard.

Table 5.11: Type of cooking fat used most of the time, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Oil or margarine used most of the time for cooking (%)	Males	84.2 (78.5–89.8)	–8.1*	0.91*
	Females	89.6 (86.7–92.5)	–3.9*	0.96*
Butter, butter blend, dripping or lard used most of the time for cooking (%)	Males	11.7 (6.5–16.9)	6.6*	2.53*
	Females	8.1 (5.5–10.7)	4.1*	1.95
No oil or margarine used for cooking (%)	Males	4.1 (1.3–9.4)	1.5	1.61
	Females	2.3 (1.3–3.8)	–0.3	0.90

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Trimming fat from meat and removing skin from chicken

The *Food and Nutrition Guidelines for Healthy Adults* (Ministry of Health 2003) recommend trimming all visible fat from meat and removing the skin from chicken. Survey participants were asked how often they removed the excess fat from meat and how often they removed the skin from chicken.

Of those who ate meat, 42.6% of Māori males and 51.6% of Māori females regularly or always trimmed the fat off meat (Table 5.12). Māori males and females were significantly less likely to regularly or always trim the excess fat from meat than non-Māori, after adjusting for age.

Of those who ate chicken, 21.7% of Māori males and 34.5% of Māori females regularly or always removed the skin off chicken. Māori males and females were significantly less likely to remove the skin off chicken than non-Māori, after adjusting for age.

Table 5.12: Trimming fat from meat and removing skin from chicken, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Regularly or always trim fat off meat among those who eat meat (%)	Males	42.2 (33.8–50.7)	–13.7*	0.76*
	Females	51.6 (46.2–57.0)	–16.3*	0.76*
Regularly or always remove skin off chicken among those who eat chicken (%)	Males	21.7 (16.3–27.0)	–21.0*	0.52*
	Females	34.5 (28.8–40.2)	–21.9*	0.61*

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Use of salt

The *Food and Nutrition Guidelines for Healthy Adults* (Ministry of Health 2003) encourage reducing sodium consumption by preparing foods with minimal added salt. If salt is used, the Ministry of Health recommends using iodised salt.

Survey participants were asked how often they added salt to their food after it has been cooked or prepared. They were also asked how often they choose low- or reduced-salt varieties of foods instead of the standard variety. Where possible, survey interviewers viewed the salt packet used in the household to determine the use of iodised salt.

Overall, 31.8% of Māori males and 37.4% of Māori females never or rarely add salt to food (Table 5.13). Māori males and females were less likely to never or rarely add salt to food than non-Māori.

Of those who used salt at home, 87.8% of Māori males and 84.3% of Māori females used iodised salt. There was no significant difference between Māori and non-Māori males and females in the use of iodised salt, after adjusting for age.

Table 5.13: Use of salt, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori [1]	
			Difference	Ratio
Never or rarely add salt to food (%)	Males	31.8 (24.5–39.1)	–12.2*	0.73*
	Females	37.4 (32.0–42.9)	–17.9*	0.67*
Iodised salt used at home among those who use salt (%)	Males	87.8 (83.5–92.1)	1.1	1.01
	Females	84.3 (79.6–89.0)	–1.1	0.99

Source: 2008/09 New Zealand Adult Nutrition Survey.

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Consumption of pre-prepared foods

The *Food and Nutrition Guidelines for Healthy Adults* (Ministry of Health 2003) recommend choosing pre-prepared foods and snacks that have minimal added fat, especially saturated fat, and that are low in salt. Survey participants were asked how often they ate fast food or takeaways from places like McDonalds, KFC, Burger King, pizza shops, or fish and chip shops. They were also asked how often they ate hot chips, French fries, wedges or kumara chips.

Ten percent of Māori males and females ate fast food and takeaways three or more times a week (Table 5.14). Māori females were three times more likely than non-Māori females to consume fast food or takeaways three or more times a week, after adjusting for age. There was no difference in fast food and takeaways consumption between Māori and non-Māori males, after adjusting for age.

Overall, 14.5% of Māori males and 12.6% of Māori females ate hot chips three or more times a week. Māori females were three times more likely to eat hot chips three or more times a week than non-Māori females. There was no difference between Māori and non-Māori males, after adjusting for age.

Table 5.14: Consumption of pre-prepared foods, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Eat fast food or takeaways 3 or more times a week (%)	Males	10.1 (6.8–13.5)	–0.3	0.97
	Females	11.2 (8.3–14.1)	7.2*	3.01*
Eat fast food or takeaways 1–2 times a week (%)	Males	39.8 (33.2–46.5)	4.6	1.14
	Females	34.5 (29.4–39.7)	6.6*	1.24
Eat fast food or takeaways less than once a week or never (%)	Males	50.0 (44.2–55.8)	–4.4	0.92
	Females	54.3 (49.3–59.3)	–13.8*	0.80*
Eat hot chips 3 or more times a week (%)	Males	14.5 (10.1–18.9)	0.7	1.05
	Females	12.6 (9.7–15.4)	8.1*	3.16*
Eat hot chips 1–2 times a week (%)	Males	48.0 (42.0–54.1)	4.2	1.10
	Females	39.3 (34.3–44.2)	6.9*	1.21*
Eat hot chips less than once a week or never (%)	Males	37.4 (31.5–43.4)	–4.8	0.89
	Females	48.2 (43.0–53.3)	–14.9*	0.77*

Source: 2008/09 New Zealand Adult Nutrition Survey.

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Consumption of soft drinks or energy drinks

The *Food and Nutrition Guidelines for Healthy Adults* (Ministry of Health 2003) recommend limiting the consumption of fruit juice, cordial, energy and soft drinks because of their high sugar content. Survey participants were asked how often they drank soft drinks or energy drinks (not including diet varieties).

About 41.8% of Māori males and 29.1% of Māori females drank soft drinks or energy drinks three or more times a week (Table 5.15). Māori females were 1.5 times more likely to drink soft drinks or energy drinks three or more times a week than non-Māori females, after adjusting for age. There was no significant difference between Māori and non-Māori males, after adjusting for age.

Table 5.15: Soft drink or energy drink consumption, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Drink soft drinks or energy drinks 3 or more times a week (%)	Males	41.8 (35.8–47.9)	6.2	1.19
	Females	29.1 (25.2–33.0)	9.6*	1.53*
Drink soft drinks or energy drinks 1−2 times a week (%)	Males	24.6 (19.2–30.0)	1.1	1.05
	Females	20.6 (16.4–24.8)	1.9	1.10
Drink soft drinks or energy drinks less than once a week or never (%)	Males	33.6 (28.6–38.6)	–7.3*	0.84*
	Females	50.3 (45.5–55.1)	–11.5*	0.82*

Source: 2008/09 New Zealand Adult Nutrition Survey.

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

6 Household food security

Food security is defined as the ready availability of sufficient, nutritionally adequate and safe foods, as well as the ability to acquire such foods in a socially acceptable way (Parnell et al 2001). Survey participants were asked eight questions on food security on behalf of themselves (if they lived alone) or their households.

Based on the distribution of the participants' responses to these statements, households were then assigned to the following three categories:

- *fully/almost fully food secure* – this included households providing no affirmative response to any of the eight statements and households responding to only one statement, which was most likely to be 'the variety of food is limited'
- *low food security* – this included households most likely to report 'relying on others for food or money for food' and 'using special food grants or food banks to acquire the food they needed'
- *moderate food security* – this included households likely to respond positively to the remaining five statements ('I/we can afford to eat properly', 'food runs out due to lack of money', 'eat less because of lack of money', 'stressed because of not having enough money for food', 'stressed because can't provide the food I want for social occasions').

The majority of Māori males and females lived in households that had moderate or low food security (Table 6.1). Māori males and females were over twice as likely to live in households that had *low food security* than non-Māori males and females, after adjusting for age. Māori males and females were 1.4 times more likely to live in households that had *moderate food security* and were less likely to live in households that were *fully/almost food secure* than non-Māori, after adjusting for age.

Table 6.1: Household food security, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Low food security (%)	Males	13.9 (10.5–17.3)	8.2*	2.63*
	Females	18.4 (14.8–22.0)	9.2*	2.11*
Moderate food security (%)	Males	48.5 (42.0–55.0)	14.2*	1.42*
	Females	48.3 (43.7–52.9)	12.3*	1.35*
Full/almost full food security (%)	Males	37.6 (31.0–44.2)	–22.5*	0.63*
	Females	33.3 (28.9–37.7)	–21.5*	0.62*

Source: 2008/09 New Zealand Adult Nutrition Survey.

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Time trends in household food security

From 1997 to 2008/09 there was a significant decrease in the proportion of Māori living in households that were fully or almost food secure (Table 6.2). There was an increase in the proportion Māori females who lived in households that were moderately food secure.

Table 6.2: Household food security, Māori, by sex,[1] 1997 and 2008/09

	Sex	1997 (95% CI)	2008/09 (95% CI)	Ratio	Trend for non-Māori
Low food security (%)	Males	4.1 (1.7–8.0)	13.3 (10.0–16.6)	3.25	↑
	Females	12.0 (7.1–16.8)	17.6 (13.8–21.3)	1.47	↑
Moderately food secure (%)	Males	40.5 (31.0–49.9)	47.8 (41.0–54.7)	1.18	↑
	Females	35.6 (29.4–41.7)	47.7 (42.8–52.7)	1.34 ↑	↑
Fully/almost food secure (%)	Males	55.4 (45.7–65.1)	38.9 (32.5–45.3)	0.70 ↓	↓
	Females	52.5 (45.3–59.7)	34.7 (30.4–39.1)	0.66 ↓	↓

Source: 1997 National Nutrition Survey; 2008/09 New Zealand Adult Nutrition Survey.

1 Age-standardised to WHO world population.

↑ Statistically significant increase from 1997 to 2008/09 at p-value < 0.05.

↓ Statistically significant decrease from 1997 to 2008/09 at p-value < 0.05.

7 Nutrition-related health outcomes

Body mass index and body size

A healthy body size is important for good health and wellbeing. Obesity is associated with a long list of health conditions, including: cardiovascular disease (ischaemic heart disease, high blood pressure and stroke), various types of cancer, type 2 diabetes, osteoarthritis, sleep apnoea, and psychological and social problems (WHO 2000; World Cancer Research Fund and American Institute for Cancer Research 2007).

Body mass index (BMI) is a measure of weight, adjusted for height, and is calculated by dividing weight in kilograms by height in metres squared (kg/m^2). BMI is used internationally to classify underweight, overweight and obesity, providing a good estimate of the proportion of the population with increased risk of health conditions associated with excess body fatness (WHO 2000).

In the 2008/09 NZANS, participants (excluding pregnant women) had their weight and height measured using professional anthropometric equipment and standardised techniques (see the *Methodology Report* for details).

Body mass index

Māori males had a mean BMI of 29.9 kg/m^2 and Māori females had a mean BMI of 30.7 kg/m^2 (Table 7.1). Māori males and Māori females had a significantly higher mean BMI than non-Māori males and non-Māori females, respectively, after adjusting for age.

Table 7.1: Mean body mass index, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Body mass index (kg/m^2)	Males	29.9 (28.9–30.8)	3.3*	1.12*
	Females	30.7 (29.8–31.5)	3.9*	1.15*

Source: 2008/09 New Zealand Adult Nutrition Survey.

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Body size

The following World Health Organization (WHO 2007) BMI cut-off points were used for adults aged 18 years and over:

- underweight: BMI < 18.50 kg/m^2
- normal weight: BMI 18.50–24.99 kg/m^2
- overweight: BMI 25.00–29.99 kg/m^2
- obese: BMI ≥ 30.00 kg/m^2.

For participants aged 15–18 years, the sex- and age-specific BMI cut-off points developed by the International Obesity Taskforce (IOTF) were used to define underweight, normal range, overweight and obesity (Cole et al 2000, 2007). The IOTF BMI cut-off points coincide with the WHO BMI cut-off points for adults at age 18 years. The same BMI cut-off points have been used for all ethnic groups.

Twenty-four percent of Māori males and 22% of Māori females had a normal weight (Table 7.2). About 35% of Māori males and 30% of Māori females were overweight. Forty-one percent of Māori males and 48% of Māori females were obese.

Māori males were 1.7 times more likely to be obese than non-Māori males, after adjusting for age. Māori females were twice as likely to be obese as non-Māori females, after adjusting for age. Māori males were less likely to be of normal weight and Māori females were less likely to be underweight and of normal weight than non-Māori males and females, respectively.

Table 7.2: Body size, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Underweight (%)	Males	0	–	–
	Females	0.5 (0.1–1.0)	–1.4*	0.32*
Normal weight (%)	Males	24.4 (17.6–31.2)	–12.4*	0.64*
	Females	21.7 (16.7–26.7)	–21.0*	0.50*
Overweight (%)	Males	34.9 (28.6–41.1)	–5.2	0.87
	Females	29.7 (24.5–34.8)	–3.0	0.90
Obese (%)	Males	40.7 (34.5–46.9)	18.5*	1.74*
	Females	48.1 (41.9–54.4)	25.4*	2.05*

Source: 2008/09 New Zealand Adult Nutrition Survey.

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Time trends in BMI and obesity

There was an increase in BMI in both Māori males and females from 1997 to 2008/09. There was no significant change in the prevalence of obesity for Māori males and females between 1997 and 2008/09.

Table 7.3: Body size, Māori, by sex,[1] 1997 and 2008/09

	Sex	1997 (95% CI)	2008/09 (95% CI)	Ratio	Trend for non-Māori
Mean BMI (kg/m^2)	Males	29.0 (28.2–29.9)	30.3 (29.6–31.0)	1.04 ↑	↑
	Females	29.1 (28.2–30.0)	30.8 (30.1–31.6)	1.06 ↑	↑
Obese (%)	Males	41.0 (33.3–48.8)	42.7 (38.2–47.2)	1.04	↑
	Females	40.4 (33.2–47.6)	48.3 (42.7–54.0)	1.20	↑

Source: 1997 National Nutrition Survey; 2008/09 New Zealand Adult Nutrition Survey.

1 Age-standardised to WHO world population.

↑ Statistically significant increase from 1997 to 2008/09 at p-value < 0.05.

Blood pressure

High blood pressure is an important risk factor for heart disease, stroke and renal failure. The relationship between blood pressure and cardiovascular disease is continuous, with the risk increasing as blood pressure increases even among those within the 'normal' range. Systolic blood pressure is a better predictor of cardiovascular disease risk than diastolic blood pressure (Prospective Studies Collaboration 2002; Neaton et al 1992).

In the 2008/09 NZANS, participants had blood pressure measured using an OMRON HEM 907 instrument. Blood pressure was not measured in pregnant women because pregnancy alters a woman's blood pressure.

Māori males had a mean systolic blood pressure of 131 mmHg and a mean diastolic blood pressure of 77 mmHg (Table 7.4). Māori females had a mean systolic blood pressure of 120 mmHg and a mean diastolic blood pressure of 76 mmHg.

Māori males and Māori females had a significantly higher mean systolic and mean diastolic blood pressure than non-Māori males and non-Māori females, respectively, after adjusting for age.

Table 7.4: Blood pressure, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Mean systolic blood pressure (mmHg)	Males	131 (129–133)	2.8*	1.02*
	Females	120 (118–123)	2.9*	1.02*
Mean diastolic blood pressure (mmHg)	Males	77 (76–79)	4.2*	1.06*
	Females	76 (74–77)	3.4*	1.05*

Source: 2008/09 New Zealand Adult Nutrition Survey.

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Cholesterol

Blood cholesterol is an important risk factor for cardiovascular disease, particularly ischaemic heart disease. The relationship between cholesterol and cardiovascular disease is continuous, with the risk increasing as cholesterol increases, even among those within the 'normal' range. Modifiable determinants of blood cholesterol include diet (in particular dietary fat intake), body weight and physical activity levels.

Total cholesterol consists largely of the cholesterol in low-density lipoprotein particles (LDL cholesterol) plus the cholesterol in high-density lipoprotein (HDL cholesterol). LDL cholesterol is associated with a higher risk of cardiovascular disease and HDL with a lower risk. The total:HDL cholesterol ratio is also a strong predictor of vascular disease mortality (Prospective Studies Collaboration et al 2007; Erqou et al 2009), with the optimum ratio being < 4.5 (New Zealand Guidelines Group 2003). Blood samples in the 2008/09 NZANS were non-fasting, so LDL cholesterol could not be measured.

Mean total cholesterol was 5.17 mmol/L for Māori males and 4.81 mmol/L for Māori females. Māori females had a significantly lower mean total cholesterol level and a significantly lower mean HDL cholesterol level than non-Māori females, after adjusting for age (Table 7.5), with no difference in the mean total cholesterol:HDL ratio. There were no significant differences in total and HDL cholesterol levels between Māori and non-Māori males, after adjusting for age.

Overall, 37.0% of Māori males and 17.1% of Māori females had a total cholesterol:HDL ratio ≥ 4.5, with no significant differences between Māori and non-Māori males or females, after adjusting for age.

Table 7.5: Cholesterol, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Mean total cholesterol (mmol/L)	Males	5.17 (4.99–5.35)	0.13	1.03
	Females	4.81 (4.67–4.94)	–0.24*	0.95*
Mean HDL cholesterol (mmol/L)	Males	1.22 (1.17–1.26)	0.02	0.99
	Females	1.37 (1.33–1.40)	–0.12*	0.92*
Mean total cholesterol:HDL ratio	Males	4.47 (4.24–4.69)	0.18	1.04
	Females	3.65 (3.52–3.78)	0.10	1.03
Total cholesterol:HDL ratio ≥ 4.5 (%)	Males	37.0 (30.2–43.7)	1.9	1.05
	Females	17.1 (13.4–20.7)	1.5	1.10

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Time trends in cholesterol

From 1997 to 2008/09 mean total cholesterol decreased and HDL cholesterol increased in Māori males and females.

Since 1997 there has been a marked decrease in the proportion of Māori adults who have a total cholesterol:HDL ratio of ≥ 4.5: an approximately 50% decrease for Māori males and a 65% decrease for Māori females.

Table 7.6: Cholesterol, Māori, by sex,[1] 1997 and 2008/09

	Sex	1997 (95% CI)	2008/09 (95% CI)	Ratio	Trend for non-Māori
Mean total cholesterol level (mmol/L)	Males	6.08 (5.68–6.48)	5.17 (5.00–5.34)	0.85 ↓	↓
	Females	5.42 (5.27–5.56)	4.86 (4.74–4.98)	0.90 ↓	↓
Mean HDL cholesterol level (mmol/L)	Males	1.11 (1.05–1.17)	1.22 (1.18–1.27)	1.10 ↑	↑
	Females	1.20 (1.14–1.25)	1.37 (1.34–1.41)	1.15 ↑	↑
Mean total cholesterol:HDL ratio	Males	5.84 (5.33–6.36)	4.44 (4.27–4.61)	0.76 ↓	↓
	Females	4.81 (4.49–5.14)	3.67 (3.54–3.80	0.76 ↓	↓
Total cholesterol:HDL ratio ≥ 4.5 (%)	Males	74.3 (65.8–82.9)	37.5 (30.2–44.8)	0.50 ↓	↓
	Females	50.2 (41.7–58.8)	17.4 (13.4–21.4)	0.35↓	↓

Source: 1997 National Nutrition Survey; 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

↑ Statistically significant increase from 1997 to 2008/09 at p-value < 0.05.

↓ Statistically significant decrease from 1997 to 2008/09 at p-value < 0.05.

Diabetes and HbA1c

Diabetes is a metabolic condition which results in raised blood glucose. It is an important cause of morbidity and mortality in New Zealand. The presence of diabetes can lead to cardiovascular disease, blindness, kidney disease and vascular insufficiency. These vascular problems may lead to nerve damage in the feet, and on occasion require amputation of the lower leg (Powers 2005).

Measurement of glycated haemoglobin (HbA1c) is the standard method for assessing long-term glycaemic (blood glucose level) control (over the previous 6–8 weeks) in people with diabetes (Powers 2005). It is the primary predictor of long-term complications of diabetes, with an HbA1c < 7.0% being the target for most people with diabetes (Powers 2011). HbA1c can also be used as a diagnostic test for diabetes, with the diagnosis of diabetes made if HbA1c is ≥ 6.5% (International Expert Committee 2009; WHO 2011).

Survey participants were asked if they had ever been told by a doctor that they have diabetes (other than during pregnancy) and had HbA1c levels measured by a blood test.

The prevalence of total diabetes has been calculated by combining the prevalence of diabetes diagnosed by a doctor and the prevalence of undiagnosed diabetes (not diagnosed by a doctor and HbA1c ≥ 6.5%). The denominator for diagnosed diabetes includes all participants, whereas the denominator for undiagnosed diabetes only includes participants who reported they had not been diagnosed with diabetes and provided a blood sample. Therefore, total diabetes is not equal to the sum of diagnosed and undiagnosed because the denominators differ.

Overall, 9.7% of Māori males and 9.8% of Māori females aged 15 years and over have diabetes (combined diagnosed and undiagnosed). Among Māori not diagnosed with diabetes and who provided a blood sample, 2.0% of males and 2.7% of females had HbA1c levels ≥ 6.5%, which is indicative of undiagnosed diabetes.

Māori females were nearly twice as likely to have diabetes (diagnosed and undiagnosed) as non-Māori females, after adjusting for age. There was no significance difference between Māori and non-Māori males in the prevalence of diabetes (diagnosed and undiagnosed).

Among Māori adults diagnosed with diabetes, 25.7% of Māori males and 44.0% of females had good control of blood glucose levels (HbA1c < 7%). Māori males were half as likely to have good control as non-Māori males, after adjusting for age. There was no difference in the proportion with good diabetes control between Māori females and non-Māori females.

Table 7.7: HbA1c and diabetes, Māori, by sex

		Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
				Difference	Ratio
Diabetes	Diabetes diagnosed by a doctor (%)	Males	6.8 (4.3–9.3)	4.4*	1.99
		Females	7.1 (4.7–9.5)	6.2*	3.29*
	Undiagnosed diabetes[2] (%)	Males	2.0 (0.7–4.4)	0.0	0.98
		Females	2.7 (1.4–4.6)	1.5	2.31
	Total diabetes (diagnosed and undiagnosed)[3] (%)	Males	9.7 (6.0–13.5)	1.3	1.19
		Females	9.8 (6.5–13.1)	3.4*	1.78*
Good management among those diagnosed with diabetes (HbA1c < 7.0%) (%)		Males	25.7 (8.8–50.6)	–25.0	0.50*
		Females	44.0 (19.2–71.3)	–1.5	0.97

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

2 Not diagnosed by a doctor and HbA1c ≥ 6.5%.

3 Total diabetes is not equal to the sum of diagnosed and undiagnosed because the denominators differ.

* Indicates a statistically significant result at p-value < 0.05.

Folate status

Folate is essential for DNA synthesis and is especially important during periods of increased cell replication and growth. Folate has a role in erythropoiesis (red blood cell formation/production), and therefore a deficiency in this vitamin can result in megaloblastic anaemia (Mann and Truswell 2007).

Inadequate folic acid levels during pregnancy have been associated with an increased risk of neural tube defects (NTDs), a major group of birth defects in the developing foetus (MRC Vitamin Study Research Group 1991). To reduce the incidence of NTDs, the Ministry of Health recommends that women of child-bearing age who plan to become pregnant take 800 µg of folic acid daily for at least four weeks prior to conception and for 12 weeks after conceiving.

Since 1996 voluntary fortification of selected foods (eg, breakfast cereals, flour, breads) with folic acid has been permitted. A standard for the mandatory fortification of bread with folic acid was to come into effect in September 2009, but the implementation of the standard was deferred for review in May 2012. In the interim, the bread industry has agreed to increase the fortification of bread with folic acid voluntarily. Because the 2008/09 NZANS took place before any increase in uptake of voluntary folic acid fortification, the results presented in this report will provide a baseline with which the effects of this increased voluntary fortification can be compared.

Folate status can be assessed by direct measurement of folate in serum and red blood cells. Red blood folate concentration is an indicator of long-term status, while serum folate indicates folate status at the time the blood sample was drawn. Red blood folate status is presented in this report. Low red blood folate status was defined as red blood folate < 317 nmol/L (Wright et al 1998).

Mean red blood folate concentrations were 804 nmol/L for Māori males and 785 nmol/L for Māori females (Table 7.8). The prevalence of low red blood folate was low for Māori males and females.

There were no significant differences in mean red blood cell folate or prevalence of low red blood folate between Māori and non-Māori males, after adjusting for age. Māori females had a significantly lower mean red blood folate than non-Māori females, but there was no difference in the prevalence of low red blood folate, after adjusting for age.

The NTD risk is associated with red blood folate levels in a continuous dose–response relationship (Daly et al 1995). Red blood cell (RBC) folate levels ≥ 906 nmol/L are associated with a very low risk of NTD, and levels ≤ 339 nmol/L are associated with a high risk.

Less than 5% of Māori women have a red blood folate concentration associated with a higher risk of an NTD-affected pregnancy. There were no differences between Māori and non-Māori females in terms of low or high risk of having an NTD-affected pregnancy, after adjusting for age.

Table 7.8: Folate status, Māori, by sex

		Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
				Difference	Ratio
Red blood folate	Mean red blood folate (nmol/L)	Males	804 (737–872)	–75.2	0.92
		Females	785 (739–830)	–86.3*	0.90*
	Low red blood folate (< 317 nmol/L) (%)	Males	2.2 (0.2–8.6)	0.1	1.04
		Females	2.8 (1.0–4.5)	–0.2	0.92
Risk of NTD-affected pregnancy: females 16–44 years	Low risk (red blood folate ≥ 906 nmol/L) (%)	Females 16–44 years	23.9 (16.9–30.9)	–2.7	0.90
	High risk of NTDs (red blood cell folate ≤ 339 nmol/L) (%)	Females 16–44 years	4.5 (0.5–15.3)	0	1.00

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

* Indicates a statistically significant result at p-value < 0.05.

Iron status

Iron is an essential component of haemoglobin, which is the component of red blood cells that transports oxygen and myoglobin in the muscle cells (Rolfes et al 2009). There are three stages of iron deficiency. In the first stage, body iron stores start to become depleted but red cell production is not affected. In the second stage (iron deficiency without anaemia), body iron stores are depleted and levels of circulating iron start to fall, although blood haemoglobin concentrations are maintained. In the final stage (iron deficiency with anaemia), body iron stores are severely depleted and the amount of iron circulating is very low, which results in reduced red cell production and low haemoglobin concentrations. Women aged 15–44 are at high risk of iron deficiency because of iron loss due to menstruation.

There are few symptoms associated with low iron stores, but iron deficiency without anaemia and iron deficiency with anaemia are associated with impaired immune function, decreased work capacity, fatigue and some specific cognitive learning effects (Mann and Truswell 2007). A range of biochemical indices are needed to assess all stages of iron deficiency, which are noted underneath Table 7.9. Note that iron deficiency anaemia is a subset of iron deficiency.

In foods, haem iron is found in meat, fish and poultry and is better absorbed by the body than non-haem iron. Non-haem iron comes from most foods and its absorption is improved by consuming foods containing a meat, fish and poultry factor and vitamin C during the same meal (Mann and Truswell 2007; Rolfes et al 2009). Foods containing phytate and polyphenol, such as whole-grain cereals, nuts, legumes, tea, coffee and some vegetables, reduce the absorption of iron.

Ten percent of Māori females have low iron stores (Table 7.9); 4.8 % Māori females had iron deficiency with anaemia. There were no significant differences in the prevalence of low iron stores or iron deficiency between Māori and non-Māori females, after adjusting for age.

The proportion of Māori males with low iron stores and iron deficiency was very low. There was a significantly lower proportion of Māori males with low iron stores and iron deficiency (but not iron deficiency with anaemia) than non-Māori males, after adjusting for age.

Table 7.9: Iron status, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Low iron stores (%)[2]	Males	0.2 (0.0–1.4)	–1.5*	0.12*
	Females	10.1 (6.0–14.2)	0.9	1.11
	Females 16–44 years	12.2 (6.8–19.5)	1.5	1.14
Iron deficiency with or without anaemia (%)[3]	Males	0.2 (0.0–1.4)	–1.0	0.16*
	Females	9.4 (5.4–13.3)	1.9	1.27
	Females 16–44 years	11.3 (5.8–19.2)	2.6	1.30
Iron deficiency with anaemia (%)[4]	Males	0.2 (0.0–1.5)	–0.4	0.34
	Females	4.8 (1.6–8.0)	1.0	1.32
	Females 16–44 years	5.9 (0.3–24.6)	2.2	1.65

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

2 Serum ferritin < 12 µg/L. Serum ferritin concentration data for participants with serum C-reactive protein > 8 mg/L were not included in calculations of either serum ferritin or iron status.

3 Serum ferritin < 12 µg/L and zinc protoporphyrin > 60 µmol/mol.

4 Serum ferritin < 12 µg/L and zinc protoporphyrin > 60 µmol/mol, and haemoglobin < 136 g/L males 15–19 years; < 137 g/L males 20–49 years; < 133 g/L males 50–69 years; < 124 g/L males 70+ years; < 120 g/L females 15–69 years; < 118 g/L females 70+ years.

* Indicates a statistically significant result at p-value < 0.05.

Time trends in iron status

The prevalence of low iron stores and iron deficiency in Māori males was very low in both 1997 and 2008/09. From 1997 to 2008/09 there were no significant changes in the prevalence of low iron stores, iron deficiency or iron deficiency with anaemia in Māori females.

Table 7.10: Iron status, Māori women, 1997 and 2008/09[1]

	1997	2008/09	Ratio	Trend for non-Māori
Low iron stores (%)[2]	9.7 (5.0–14.4)	9.6 (5.5–13.8)	0.99	nc
Iron deficiency with or without anaemia (%)[3]	7.6 (3.5–13.8)	9.2 (4.9–13.4)	1.21	↑
Iron deficiency with anaemia (%)[4]	5.6 (2.2–11.2)	4.1 (0.4–15.1)	0.74	nc

Source: 1997 National Nutrition Survey; 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

2 Serum ferritin < 12 µg/L. Serum ferritin concentration data for participants with serum C-reactive protein > 8 mg/L were not included in calculations of either serum ferritin or iron status.

3 Serum ferritin < 12 µg/L and zinc protoporphyrin > 60 µmol/mol.

4 Serum ferritin < 12 µg/L and zinc protoporphyrin > 60 µmol/mol, and haemoglobin < 136 g/L males 15–19 years; < 137 g/L males 20–49 years; < 133 g/L males 50–69 years; < 124 g/L males 70+ years; < 120 g/L females 15–69 years; < 118 g/L females 70+ years.

↑ Statistically significant increase from 1997 to 2008/09 at p-value < 0.05.

↓ Statistically significant decrease from 1997 to 2008/09 at p-value < 0.05.

Iodine status

Iodine is an essential component of thyroid hormones, which play a critical role in maintaining the body's metabolic rate and normal growth and mental development. There is a wide spectrum of iodine deficiency disorders (IDD) affecting all life-cycle groups, from the foetus to adult. Mild to moderate iodine deficiency can cause thyroid problems, including the development of a goitre (enlarged thyroid gland) and hypothyroidism. Severe iodine deficiency during foetal development impairs mental development (Mann and Truswell 2007).

More than 90% of iodine is excreted in the urine, so urinary iodine is a good indicator of recent iodine status. The following International Council for the Control of Iodine Deficiency Disorders (WHO 2007) cut-offs for iodine deficiencies were used to assess iodine deficiency. Where urinary iodine concentration was measured as 0–10 µg/L, it was replaced with the value 10 µg/L, which is the lowest detectable limit of the assay (ICCIDD 2000).

- Mild iodine deficiency is defined as a median urinary iodine concentration of 50–99 µg/L.
- Moderate iodine deficiency is defined as a median urinary iodine concentration of 20–49 µg/L.

Most soils in New Zealand are low in iodine, resulting in low concentrations in locally produced foods. The iodisation of salt was introduced in 1924 to improve iodine intakes, but most convenience and manufactured foods do not use iodised salt. Due to the re-emergence of iodine deficiency in New Zealand, it became mandatory for bread manufacturers to use iodised salt in all commercially prepared bread (other than organic and unleavened bread) on 27 September 2009. While a small proportion of participants (10%) provided blood samples after 27 September 2009, the survey is

considered to provide an indication of iodine status prior to mandatory iodine fortification.

The median urinary iodine concentration (MUIC) was 55 µg/L for Māori males and 57 µg/L for Māori females (Table 7.11). There were no significant differences in the median urinary iodine concentration between Māori and non-Māori males and Māori and non-Māori females, after adjusting for age.

In the Māori population, 43% of males and 44% of females had urinary iodine concentrations < 50 µg/L, and 79% of males and 80% of females had concentrations < 100 µg/L. The ICCIDD suggests that no more than 20% of a population should have urinary iodine concentrations below 50 µg/L. There was no difference between Māori and non-Māori males and Māori and non-Māori females in the proportion of the population with a MUIC < 100 µg/L, after adjusting for age. Māori females were significantly less likely to have a MUIC < 50 µg/L than non-Māori females, after adjusting for age.

As from 1 July 2010, a subsidised iodine-only tablet (150 µg) has been available in New Zealand, which the Ministry of Health recommends that all pregnant and breastfeeding women take once a day.

Table 7.11: Iodine status, Māori, by sex

	Sex	Māori (95% CI)	Māori compared with non-Māori[1]	
			Difference	Ratio
Median urinary iodine concentration (µg/L)[2]	Males	55 (44–65)	^	^
	Females	57 (51–63)	^	^
Urinary iodine concentration < 50 µg/L (%)[3]	Males	43 (35–53)	–2%	0.95
	Females	44 (37–51)	–8%	0.84*
Urinary iodine concentration < 100 µg/L[3]	Males	79 (70–86)	–3%	0.97
	Females	80 (74–85)	–2%	0.97

Source: 2008/09 New Zealand Adult Nutrition Survey

1 Age-standardised to WHO world population.

2 Mild iodine deficiency: median urinary iodine concentration 50–99 µg/L; moderate iodine deficiency: median urinary iodine concentration 20–49 µg/L; severe iodine deficiency: median urinary iodine concentration < 20 µg/L.

3 WHO/UNICEF/ICCIDD recommend that no more than 50% of the population have an MUIC < 100 µg/L, and no more than 20% have an MUIC < 50 µg/L.

^ Confidence intervals for rate ratio and rate difference could not be calculated for median urinary iodine concentration.

References

Ahmad O, Boshci-Pinto C, Lopez A, et al. 2000. *Age-standardization of Rates: A new WHO standard.* Geneva: World Health Organization.

Cho S, Dietrich M, Brown CJ, et al. 2003. The effect of breakfast type on total daily energy intake and body mass index: results from the Third National Health and Nutrition Examination Survey (NHANES III). *Journal of the American College of Nutrition* 22: 296–302.

Cole TJ, Bellizzi MC, Flegal KM, et al. 2000. Establishing a standard definition for child overweight and obesity worldwide: International survey. *British Medical Journal* 320: 1240–5.

Cole TJ, Flegal KM, Nicholls D, et al. 2007. Body mass index cut offs to define thinness in children and adolescents: international survey. *British Medical Journal* 335: 194–201.

Daly LE, Kirke PN, Molloy A, et al. 1995. Folate levels and neural tube defects: implications for prevention. *Journal of the American Medical Association* 274: 1698–702.

Erqou S, Kaptoge S, Perry PL, et al. 2009. Lipoprotein (a) concentration and the risk of coronary heart disease, stroke and nonvascular mortality. *Journal of the American Medical Association* 302: 412–23.

Gibson RS. 2005. *Principles of Nutritional Assessment.* New York: Oxford University Press.

ICCIDD (International Council for the Control of Iodine Deficiency Disorders). 2000. Standardization of ultrasound and urinary iodine determination for assessing iodine status: report of a technical consultation. *IDD Newsletter* 16: 19–23.

International Expert Committee. 2009. International Expert Committee Report on the role of the Alc assay in the diagnosis of diabetes. *Diabetes Care* 32(7): 1327–34.

Ma Y, Bertone ER, Stanek EJ 3rd, et al. 2003. Association between eating patterns and obesity in a free-living US adult population. *American Journal of Epidemiology* 158: 85–92.

Mann J, Truswell AS (eds). 2007. *Essentials of Human Nutrition* (3rd ed). New York: Oxford University Press.

Ministry of Health. 2003. *Food and Nutrition Guidelines for Healthy Adults: A background paper.* Wellington: Ministry of Health.

MRC Vitamin Study Research Group. 1991. Prevention of neural tube defects: results from the Medical Research Council Vitamin Study. *Lancet* 338: 131–7.

Neaton JD, Wentworth D. 1992. Serum cholesterol, blood pressure, cigarette smoking, and death from coronary heart disease: overall findings and differences by age for 316,099 white men. *Archives of Internal Medicine* 152: 56–64.

New Zealand Guidelines Group. 2003. *The Assessment and Management of Cardiovascular Risk*. Wellington: New Zealand Guidelines Group.

NHMRC. 2006. *Nutrient Reference Values for Australia and New Zealand.* Canberra, ACT: National Health and Medical Research Council.

Parnell WR, Reid J, Wilson NC, et al. 2001. Food security: is New Zealand a land of plenty? *New Zealand Medical Journal* 114: 141–5.

Powers A. 2005. Diabetes mellitus. In: D Kasper, E Braunwald, A Fauci, et al (eds). *Harrison's Online*. The McGraw-Hill Companies. URL: www.accessmedicine.com/resourceTOC.aspx?resourceID=4. Accessed 13 April 2011.

Powers AC. 2011. Diabetes mellitus. In: AS Fauci, E Braunwald, DL Kasper, et al (eds). *Harrison's Principles of Internal Medicine* (17th ed.). URL: www.accessmedicine.com/content.aspx?alD–2891108. Accessed 13 April 2011.

Prospective Studies Collaboration. 2002. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. *Lancet* 360: 1903–13.

Prospective Studies Collaboration, Lewington S, Whitlock G, et al. 2007. Blood cholesterol and vascular mortality by age, sex, and blood pressure: a meta-analysis of individual data from 61 prospective studies with 55,000 vascular deaths. *Lancet* 370: 1829–39.

Rolfes SR, Pinna K, Whitney E. 2009. *Understanding Normal and Clinical Nutrition* (8th ed). Belmont, Canada: Wadsworth Cengage Learning.

Statistics New Zealand. 2005. *Understanding and Working with Ethnicity Data: A technical paper*. Wellington: Statistics New Zealand.

University of Otago and Ministry of Health. 2011a. *A Focus on Nutrition: Key findings of the 2008/09 New Zealand Adult Nutrition Survey.* Wellington: Ministry of Health.

University of Otago and Ministry of Health. 2011b. *Methodology Report for the 2008/09 New Zealand Adult Nutrition Survey*. Wellington: Ministry of Health.

Van der Heijden AAWA, Hu FB, Rimm EB, et al. 2007. A prospective study of breakfast consumption and weight gain among US men. *Obesity* 15: 2463–9.

WHO. 2000. *Obesity: Preventing and managing the global epidemic*. Report of a WHO consultation. Technical Report Series 894. Geneva: World Health Organization.

WHO. 2007. *Global Database on Body Mass Index*. Geneva: World Health Organization.

WHO. 2011. *Use of Glycated Haemoglobin (HbA1c) in the Diagnosis of Diabetes Mellitus*. Abbreviated report of a WHO Consultation. Geneva: World Health Organization.

WHO, ICCIDD, UNICEF. 2007. *Assessment of the Iodine Deficiency Disorders and Monitoring Their Elimination* (3rd ed). Geneva: World Health Organization.

World Cancer Research Fund, American Institute for Cancer Research. 2007. *Food, Nutrition, Physical Activity and the Prevention of Cancer: A global perspective*. Washington DC: AICR.

Wright JD, Bialostosky K, Gunter EW, et al. 1998. Blood folate and vitamin B_{12}: United States, 1988–94. *Vital and Health Statistics* 11(243).