

Australia's food & nutrition 2012



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Abbreviations

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences	DAFF	Department of Agriculture, Fisheries and Forestry
ABS	Australian Bureau of Statistics	EAR	Estimated Average Requirement
ACCC	Australian Competition and Consumer Commission	FAO	Food and Agricultural Organization of the United Nations
ACT	Australian Capital Territory	FFQ	food frequency questionnaire
AFF	agriculture, forestry and fishing industry	FSANZ	Food Standards Australia New Zealand
AFGC	Australian Food and Grocery Council	GDP	gross domestic product
AGHE	Australian Guide to Healthy Eating	GM	genetically modified
AHMAC	Australian Health Ministers' Advisory Council	GP	general practitioner
AHS	Australian Health Survey	GST	goods and services tax
AI	Adequate Intake	GVA	gross value added
AIDS	acquired immunodeficiency syndrome	HDL	high density lipoprotein (cholesterol)
AIHW	Australian Institute of Health and Welfare	HIV	human immunodeficiency virus
AMDR	Acceptable Macronutrient Distribution Range	IGA	Independent Grocers of Australia
ANIFS	Australian National Infant Feeding Survey	IPCC	Intergovernmental Panel on Climate Change
ANPHA	Australian National Preventive Health Agency	IVA	industry value added
APD	Accredited Practising Dietitian	LDL	low density lipoprotein (cholesterol)
AS	Australian Standard	Manuf.	manufacturing
AusDiab	Australian Diabetes, Obesity and Lifestyle Study	MUIC	median urinary iodine concentration
Aust	Australia	NATSINSAP	National Aboriginal Torres Strait Islander Nutrition Strategy and Action Plan
BMI	body mass index	NATSIHS	National Aboriginal and Torres Strait Islander Health Survey
CAPI	computer-assisted personal interview	NFA	National Food Authority
CATI	computer-assisted telephone interview	NHMRC	National Health and Medical Research Council
COAG	Council of Australian Governments	NHMS	National Health Measures Survey
CPI	consumer price index	NHS	National Health Survey
DAA	Dietitians Association of Australia	NINS	National Iodine Nutrition Survey
		NNPAS	National Nutrition and Physical Activity Survey

NNS	National Nutrition Survey
NRV	Nutrient Reference Value
NSA	Nutrition Society of Australia
NSW	New South Wales
NT	Northern Territory
NTD	neural tube defect
OECD	Organisation for Economic Co-operation and Development
Qld	Queensland
RBC	red blood cell
RDI	recommended dietary intake
SA	South Australia
SES	socioeconomic status
SIGNAL	Strategic Intergovernmental Nutrition Alliance
Tas	Tasmania
UK	United Kingdom
UL	Upper Level of Intake
Vic	Victoria
VicHealth	Victorian Health Promotion Foundation
WA	Western Australia
WHO	World Health Organization



Symbols

—	nil or rounded to zero
..	not applicable
g	gram
HbA1c	glycated haemoglobin test
kg	kilogram (1,000 grams)
kJ	kilojoule
kt	kilotonne
L	litre
µg	microgram (1 millionth of a gram)
mg	milligram (1 thousandth of a gram)
ML	megalitre
n.a.	not available
n.p.	not publishable because of small numbers, confidentiality or other concerns about the quality of the data
ppm	parts per million

Introduction



Humanity's quest for food has helped to shape the development of society. It has profoundly influenced population growth and urban expansion, dictated economic and political theory, expanded the horizons of commerce, inspired wars of dominion and precipitated the discovery of new worlds (Tannahill 1988:xiii).

Since food is fundamental to our health and wellbeing, it is important we have a good understanding of the various components that influence and affect our food choices. This revised edition of *Australia's food & nutrition 2012* provides a timely update of the key components of our food and nutrition system.

A sound knowledge and understanding of our current food and nutrition system is crucial to respond to future challenges such as food insecurity, environmental sustainability and nutrition-related disease. It provides important information on the interactions and inter relationships between the various system components.

At the time of printing, the Australian Dietary Guidelines were under revision, and a new National Food Plan and National Nutrition Policy were being developed. This text will help provide the evidence base for the development of these important food and nutrition initiatives and be a resource for all those concerned with food and nutrition in Australia, especially public health and food professionals.

The content is based on the conceptual framework shown in Figure 1 and follows a model of 'paddock to plate'—from the food supply and distribution, to consumption, nutrition and health outcomes.

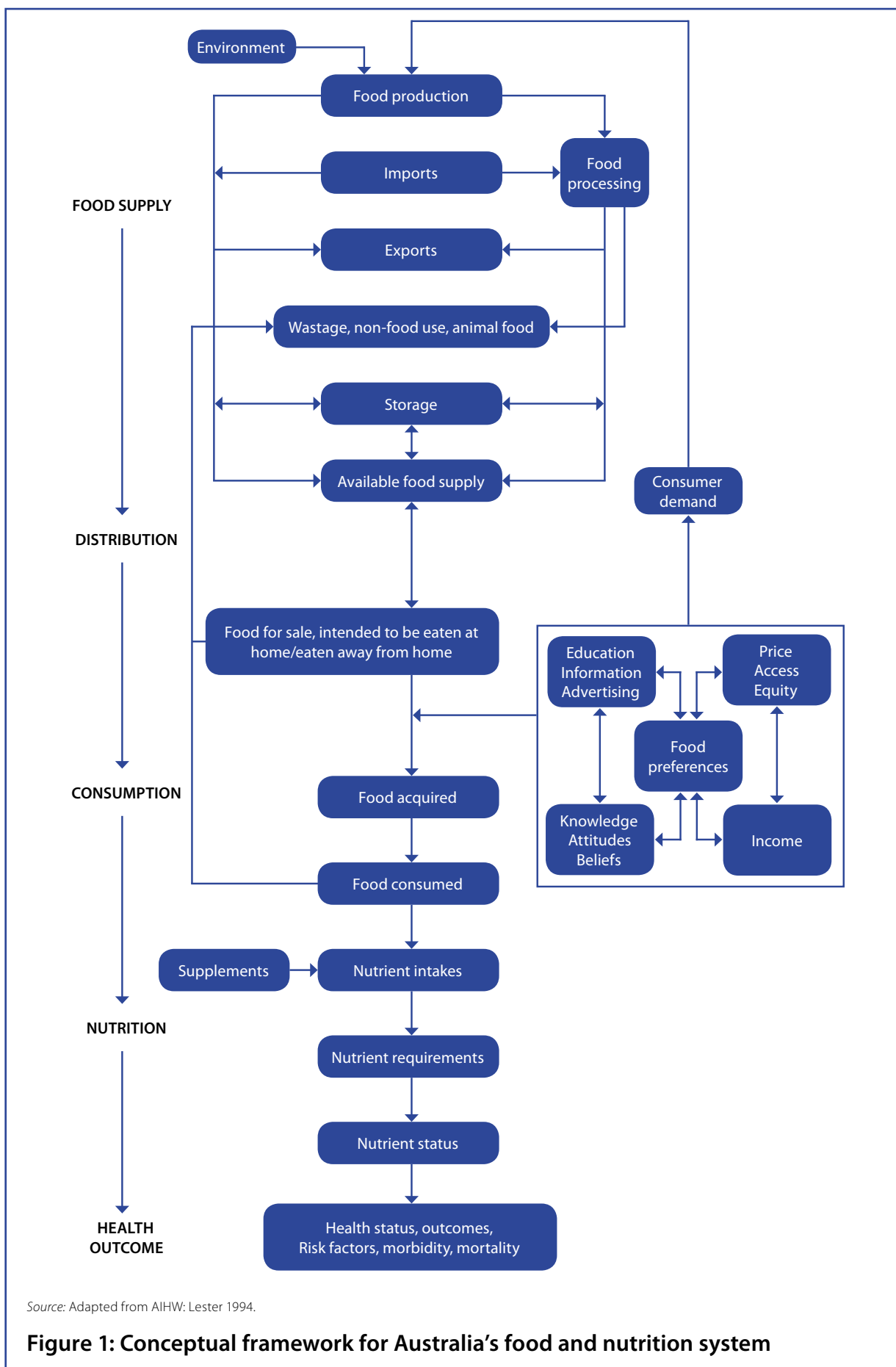
This revised edition builds on the previous 1994 edition and includes, where possible, the latest information and data available. Although some information appears rather dated, for example the 1995 National Nutrition Survey, it is the latest available to describe Australia's food and nutrition system; areas where data are lacking have been acknowledged. Overall, this information provides a baseline from which changes in the food and nutrition system can be monitored.

Motivation for the first edition of *Australia's food & nutrition* (AIHW: Lester 1994) stemmed from the introduction of the 1992 National Food and Nutrition Policy. One of the four objectives of this policy was ongoing monitoring and surveillance of the food system. Key strategies included monitoring and reporting on:

- changes in the food supply
- information on foods sold
- national dietary survey analysis, showing food and nutrient intakes of individuals
- changes in the nutritional status of the population, and
- health and morbidity data in relation to food and nutrition at the population level.

Additionally, this policy highlighted the importance of considering the food and nutrition system as a coherent entity. The first edition of *Australia's food & nutrition* brought together information from all sectors of the food and nutrition system as an initial step towards meeting the objective of ongoing food and nutrition monitoring. This revised edition further builds on these intentions.





Australia's food & nutrition 2012 is divided into four main sections:

Section 1—Context of Australia's food and nutrition system

The chapters in Section 1 provide an overview of the environmental, social, historical, cultural and political influences that have helped shape the food and nutrition system.

Chapter 1 presents a brief history of the origins and characteristics of the Australian people and environment, and how they have interacted to shape Australia's current food supply, habits and preferences.

Chapter 2 provides an overview of the global trends affecting Australia's food and nutrition system. It outlines pressing issues such as increasing world food demands, food security, climate change and diminishing resources such as arable land, fossil fuels, water and nutrients.

Chapter 3 outlines the policy environment in which Australia's food and nutrition system operates. It describes the regulatory system and the key policies that affect the food supply and consumption, and nutrition and health outcomes.

Section 2—Food production and selection

The three chapters in Section 2 describe Australia's food supply and focus on food production, selection and wastage.

Chapter 4 describes the economic value of Australia's food production system, the main food industry components, production methods, the safety of the food supply and the retail sector.

Chapter 5 describes the major influences that affect our food preferences, purchases and intakes.

Chapter 6 describes the various sources of food wastage that occur throughout the food supply chain. It highlights the social, economic and environmental issues associated with food wastage and various waste reduction strategies.

Section 3—Nutrient intakes and health status

The two chapters in this section describe the nutritional and health status of Australians.

Chapter 7 provides details on our food and nutrient intakes and how these compare with the current Australian Dietary Guidelines and health reference standards.

Chapter 8 provides details on our nutritional and health status. It describes patterns of growth and development, nutrient inadequacies and diet-related diseases.

Section 4—Food and nutrition monitoring

Chapter 9 highlights the importance of establishing a national food and nutrition monitoring system, outlines the necessary components of such a system, and identifies existing data sources that could be used for this purpose.



Key points

- The first Australians arrived more than 40,000 years ago and lived as hunter-gatherers until after European colonisation in 1788.
- From the 1800s, the pastoral industry expanded and for more than a century was the economic mainstay of Australia.
- In 2011, Australia's population was 22.6 million people, with 1 in 4 people born overseas.
- More than half of Australia's total land area is used for agriculture, with the primary use being for animal grazing.
- In recent times there has been a growing preference for convenience foods. There has also been a greater dominance by large supermarket chains and advances in food technology.
- Diet-related chronic diseases are the major cause of death and morbidity in Australia and are becoming more common.
- Certain groups are more at risk of ill health, including Aboriginal and Torres Strait Islander people, rural and remote Australians and socioeconomically disadvantaged people.

People and their environment

1





1.1 The people

Origins

The first Australians arrived via South-East Asia more than 40,000 years ago, and 20,000 years later almost the entire continent was inhabited. Estimates of the population before European settlement range from 300,000 to 750,000 people, divided into about 500 different cultural groups (ABS 1990). During the 19th and early 20th centuries, the Indigenous population declined dramatically and traditional lifestyles and practices were disrupted after settlement of Australia by Europeans (DFAT 2008a).

Permanent European settlement began in 1788 with the arrival of the First Fleet. Immigration continued at a steady pace, and in the first 100 years the population reached three million (ABS 1990). Originally, non-white immigrants were essentially excluded by the restrictions of the *Immigration Restriction Act 1901*, which required that they take a dictation test in a specific language with which they were not necessarily familiar. Non-white immigrants were often seen as a threat to working conditions in Australia and to Australia's 'British' character (Australian Government 2012a). Policies such as this were to remain in place until after World War II, when the Government expanded migration schemes.

As a proportion of the total population, Australia's overseas-born population has grown steadily since 1950, driven by migration from non-mainly English-speaking countries. Since World War II, more than 6.6 million migrants have come to Australia through the Australian Government's immigration program (DFAT 2008a).

In 2011, the Australian population reached 22.6 million people, with 1 in 4 born overseas—one-third coming from mainly English-speaking countries (the United Kingdom, Ireland, New Zealand, Canada, the United States and South Africa) and the rest from non-mainly English-speaking countries (AIHW 2012a). As at 2006, the Indigenous population (517,000 people) constituted 2.5% of the total Australian population (AIHW 2012a).

These waves of immigration (Table 1.1) have helped shape Australia's diverse culture and eating preferences.



Table 1.1: Australia's immigration waves

Date	Event
~40,000 BC	Aboriginal people migrate to Australia.
1780s	160,000 convicts are shipped to Australia.
1790s	Free immigrants begin coming to Australia.
1820s	Rapid growth of the wool industry creates large labour demands, producing a migration increase of free immigrants from the United Kingdom.
1840s	Large numbers of Irish immigrants come to Australia to escape famine.
1850s	Discovery of gold in 1851 sparks a sharp migration increase, with Chinese immigrants the largest non-British group.
1860s	Labourers from Melanesia are recruited to work on Queensland plantations.
1860s–1920s	Concerns about population imbalance result in deliberate efforts to attract women to Australia.
1900s–1950s	Arrival of Afghani, Pakistani and Turkish camel handlers helped to open up the continent's interior by constructing telegraph and railway lines.
1940s–1950s (post World War II)	Ambitious post-war migration program introduced to address labour shortages and the belief that substantial population growth was needed for the country's future. Agreements made with the United Kingdom, some European countries, including Italy and Greece, and the International Refugee Organisation to encourage migrants, including displaced persons from war-torn Europe, to come to Australia.
1950s–1960s	Economic and humanitarian events around the world influenced the size and source countries of Australia's migration program. At various times, the Netherlands, Germany, Italy, Greece, Turkey and Yugoslavia were important migrant source countries. Many post-war migrants contributed to the development of Australia's economy and infrastructure projects during this period.
1960s–1970s	Significant intakes of refugees came from Hungary, Czechoslovakia, Chile, Indochina and Poland, Greece and Italy following unrest in these countries.
1970s–2000s	Changing mix of migrants across the decades.
2008–2009	More than 171,000 migrants granted visas under the Skill and Family Streams of Australia's Migration Program. Additionally, nearly 670,000 people received temporary entry visas to undertake specific work or study. Also, 13,507 humanitarian visas granted to allow refugees to live in Australia, having fled persecution or suffering.
2011	A global migration program is in place, using one set of criteria for applicants anywhere in the world, with migrants originating from more than 185 countries.

Source: Department of Immigration and Citizenship 2009.





Current population characteristics

Table 1.2 shows selected sociodemographic characteristics of the Australian population over the last 50 years. As the Australian population has increased, the median age, and proportion of those aged 65 and over have also increased. The median age has increased by 10 years since 1958 (ABS 2011a). While the number of births has risen slowly in the last 50 years, the number of births per woman (total fertility rate) has reduced. The most recent rate (1.9 babies per woman) is below population replacement level. However, this has largely been offset by migration.

Table 1.2: Selected sociodemographic characteristics, Australia, 1958–2011

	1958	1968	1978	1988	1998	2008	2011 ^(a)
Total population	9,947,358	12,145,582	14,430,830	16,687,082	18,814,276	21,498,540	22,620,554
Median age (years)	29.9	27.8	28.9	31.6	34.8	36.8	37.1
Population aged 65 or over (per cent)	8.5	8.4	9.2	10.8	12.3	13.2	13.7
Total number of births	222,504	240,906	224,181	246,193	248,870	296,621	297,903
Total fertility rate	3.42	2.89	1.95	1.83	1.76	1.96	1.89
Net overseas migration	64,879	123,452	47,394	172,794	88,781	315,686	170,279
Male life expectancy at birth (years)	–	67.6	69.4	73.1	76.2	79.2	79.5
Female life expectancy at birth (years)	–	74.2	76.4	79.5	81.8	83.9	84.0
Total number of deaths	83,723	109,547	108,425	119,866	127,202	142,470	146,260
Standardised death rate	–	–	10.7	9.0	7.2	6.0	5.7

(a) Preliminary and estimated data.

Note: Where data are unavailable for the reference year, the closest year available has been used.

Sources: ABS 2008a, 2009a, 2011a.

Health

Generally, Australians experience good health and our health status continues to improve (AIHW 2012a). In most aspects of health, Australia matches or leads other comparable countries. Despite this reasonably good report card, certain groups are more at risk of ill health, including Aboriginal and Torres Strait Islander people, rural and remote Australians and socioeconomically disadvantaged people. Diet-related chronic diseases are the major cause of death and disability in Australia and their prevalence is increasing.

This overview of Australia's health is mainly taken from *Australia's health 2012* (AIHW 2012a). See that report and Chapter 8 for more detail.





Diseases and burden of disease

Burden of disease provides an estimate of healthy life lost due to premature death, prolonged illness or disability, or a combination of these factors. Cancers, as a group, cause the greatest disease burden in Australia, followed by cardiovascular disease, nervous system/sensory disorders and mental disorders (AIHW 2012a).

In terms of specific diseases, heart disease causes the greatest burden, followed by anxiety/depression and Type 2 diabetes. The rate of heart attacks has continued to decrease, and survival after a heart attack has increased. Cardiovascular disease death rates fell from 831 per 100,000 people in 1968 to 183 per 100,000 in 2009, a fall of 78%. Cancer death rates have also fallen, although by less than cardiovascular disease.

The prevalence of Type 2 diabetes has more than doubled between 1989–90 (1.5%) and 2007–08 (4.1%), and by 2023 is expected to be the leading cause of disease burden. This increase is linked to the rising prevalence of people who are overweight or obese, and low levels of physical activity in the population. The incidence of treated end-stage kidney disease is also increasing, with diabetes the main cause (AIHW 2012a).

Nutrition-related health risks

Tobacco smoking is the single most preventable cause of ill health and death in Australia, although rates of cigarette smoking have decreased and are now among the lowest of all Organisation for Economic Co-operation and Development (OECD) countries. In 2010, about 1 in 7 (14%) Australians aged 14 and over smoked daily (AIHW 2012a), compared with about half of all adults in the 1950s. This rate is expected to decline further in the future.

Conversely, rates of people who are overweight and obese are continuing to rise in Australia and the nation currently has one of the highest rates of obesity in the world. In 2007–08, 1 in 4 adults and 1 in 12 children were obese (AIHW 2012a). Being overweight or obese are risk factors for a number of chronic diseases, namely, coronary heart disease, Type 2 diabetes, stroke, osteoarthritis, sleep apnoea and some cancers.

Good nutrition contributes to quality of life, helps maintain healthy body weight, protects against infections, and reduces the risk of chronic disease and premature death. Alternatively, poor dietary choices are associated with many chronic diseases that are a major cause of death and disability in Australia, and their prevalence is steadily increasing. The burden of disease due to poor diet is often associated with large intakes of energy-dense foods, with high saturated fat, sugar and/or salt content, and low intakes of nutrient-dense foods, such as vegetables, fruit and wholegrain cereals (AIHW 2012a). Food consumption patterns are discussed in Chapter 7.

Regular physical activity is associated with maintaining good health, a healthy weight, and helping to prevent the onset of some chronic diseases. However, less than half of the population (40%) exercise at sufficient levels to obtain benefits to their health, as defined by national guidelines. Physical inactivity is one of the top four contributors to the burden of disease and injury in Australia; the others are tobacco smoking, high blood pressure, and overweight and obesity. A 2004 World Health Organization (WHO) study on the global burden of disease found the same top four risk factors for high-income countries as in Australia (WHO 2009).

Groups at greater risk

Aboriginal and Torres Strait Islander people

With the transition from their varied and nutrient-dense traditional diet to a Western-style diet (higher in saturated fat and refined sugars), diet-related diseases, such as Type 2 diabetes, have become more prevalent (Burns & Thomson 2008).



Compared with other Australians, Indigenous Australians as a group are more socially disadvantaged and this contributes to their poorer health status. On average, they experience higher rates of unemployment, lower educational attainment and live in more overcrowded households. They are at greater risk of unhealthy behaviours such as smoking and alcohol misuse, and are more likely to be overweight or obese (AIHW 2012a).

Aboriginal and Torres Strait Islander people are generally less healthy and die at a much younger age than other Australians. The estimated life expectancy for Indigenous males is 12 years less than non-Indigenous males, and for Indigenous females it is 10 years less than non-Indigenous females. Indigenous Australians are also more likely to experience disability and reduced quality of life due to ill health.

People in rural and remote areas

The cost of basic nutritious foods is about 30% higher in rural and remote areas than in urban and metropolitan areas (Harrison et al. 2010). The availability of quality fresh fruit and vegetables and better food choices decreases in remote communities while the cost increases.

People living in rural and remote areas tend to be less healthy and have higher mortality rates than their city counterparts. In many rural communities, the levels of education, income and employment are often lower and residents frequently experience additional occupational risks (AIHW 2008).

Rural residents are more likely to have high blood pressure, high cholesterol and to report greater levels of smoking and alcohol misuse. They are also more likely to be classified as overweight or obese (AIHW 2012a). There is often less access to health services (Humphreys & Wakeman 2008) and increased hazards from travelling great distances. While rural Australians may experience health disadvantages, the disadvantages can be greater for those who are also Indigenous.

Low socioeconomic status

Health and wellbeing are influenced by broad but closely related socioeconomic factors, such as education, occupation and income. These factors are important determinants of food choices, eating behaviours and general access to social resources and help to explain many of the health inequalities in Australia today.

Socioeconomic gradients exist for specific health conditions, such as cardiovascular disease, diabetes and injuries among young Australians. In general, relatively disadvantaged members of the community live shorter lives and have higher rates of illness, disability and death than those who are relatively advantaged (AIHW 2012a). This pattern occurs consistently within countries across the world, despite vast differences in their overall wealth.

Life expectancy and death

For Australians born in the early 1900s, life expectancy was 55 years for males and 59 years for females. Over the past century, the life expectancy of Australians has risen considerably and is now among the highest in the world—79.5 years for males and 84 years for females (AIHW 2012a).

The leading causes of death in Australia are mainly chronic diseases. In 2010, they caused 89% of all deaths (AIHW 2010a), with coronary heart disease the leading cause for both males and females, followed by lung cancer for males and stroke for females (ABS 2012a). However, death rates are falling for many of our major health problems, such as cancer, cardiovascular disease, asthma and injuries.

Mortality rates for the leading causes of death in Australia are generally lower than the average for OECD countries (AIHW 2012a).



1.2 Historical food influences

The first Australians

Australia's Aboriginal and Torres Strait Islander people lived as hunter-gatherers for thousands of years, with men predominantly the hunters and women and children the main food gatherers. Their food culture may be the longest known without external influences. Food had an important social function and helped strengthen community relationships. A formalised food-sharing system also protected individuals from malnutrition (NHMRC 2000).

Indigenous people obtained their diet from a wide range of native plants and animals. Their main beverage was water and, unlike most other cultures, no intoxicating beverages were prepared. The composition of the food supply was influenced by both the season and geographical location. The quality and quantity of food varied on a daily basis, and usual eating patterns were supplemented with feasts when large animals were hunted (NHMRC 2000).

The limited information available suggests that before European settlement, Australia's Indigenous people were healthy and survived on a traditional diet rich in nutrients and low in energy density. However, European settlement dramatically affected their traditional hunter-gatherer way of life (Gracey 2000). Many Indigenous people became dependent on Europeans for their food, as well as other resources.

European settlement

The arrival of Europeans in 1788 (Table 1.1) signalled a change from a hunter-gatherer approach to food, to one largely dependent on imported supplies. The food and beverage influences brought to Australia were typically those of Britain's urban underclass: potatoes, bread, tea, sugar, milk and meat, and this imprint has carried through to modern times.

The lack of farming experience, poor soils and harsh climate created difficulties for the first European settlers. They became heavily reliant on food arriving by ship from foreign lands. During the 1790s, the colony faced perpetual food shortages and, as a result, malnutrition and scurvy were common.

Crossing the Blue Mountains in 1819 subsequently led to the establishment and expansion of the pastoral industry. Australian soils and climate were better suited to large-scale grazing than farming and, as a result, pastoralism became the economic mainstay, with wool the single most important commodity (Pearson & Lennon 2010).

'Grazing success turned us into a nation of meat eaters' (Symons 2007). Due to the expansion of the wool industry, meat was abundantly available, relatively cheap and frequently consumed three times a day. The workforce was routinely paid in weekly rations consisting of 10 pounds (4.5 kilograms) of flour, 10 pounds (4.5 kilograms) of meat, 2 pounds (1 kilogram) of sugar, ¼ pound (100 grams) of tea and salt; eventually earning the name 'Ten, Ten, Two and a Quarter' (Symons 2007).

In the 1850s, the discovery of gold caused a rapid rise in migration, with arrivals of about 50,000 people a year. Chinese immigrants were the largest non-British group. By 1861, the settler population had reached almost 1.2 million, a threefold increase over the 1850 population of 400,000. In turn, the increased population stimulated agriculture, including dairying and the growing of wheat, sugar and fruit (Symons 2007).

In 1859, an unintended consequence of introducing 24 rabbits near Geelong in Victoria for recreational hunting was the resultant rabbit plague that had serious environmental and economic impacts. Although a notorious pest, the rabbit provided a source of food and extra income during wartime and the Great Depression (Pearson & Lennon 2010).





The expansion of railway transport (1890s onwards) enabled more of the Australian interior to be opened up for farming of wheat, dairying and irrigated horticulture, and allowed food to be transported to Australian cities and then shipped around the world. This era also signalled the rise of food processing in Australia. New technologies were introduced, such as the introduction of roller mills allowing the cheap production of white flour, and iconic Australian companies such as Arnott's, Rosella and Foster's were established (Symons 2007).

The gold rushes produced a period of prosperity that lasted 40 years. Material wellbeing improved and inventions such as gas stoves and ice chests began appearing in households. The expansion of the cities, including the provision of utilities, was the catalyst for many infrastructure changes that influenced people's food selection, preparation and lifestyle.

The 20th century

Federation (1901) led to the removal of interstate tariffs that had previously hampered trade between the colonies. As a consequence—along with improved farming techniques, railways, shipping and refrigeration—Australia's agriculture rapidly expanded and the country changed from being a net importer to a net exporter soon after (Henzell 2007).

In 1910–11, a Commonwealth inquiry found that Australia had the world's lowest cost of living, with spending on food being 29% of income, compared with the 54% to 60% of other leading nations (Symons 2007).

The end of the First World War (1918) brought a new sense of optimism and progress for many Australians. The 1920s signalled a higher level of material prosperity, along with an increase in home ownership. Refrigerators became common purchases for ordinary families. This had major implications for food preservation and probably constituted 'the single most important technological innovation with respect to our food supply' (Wahlqvist 1983:15). Many of the traditional ways of preserving food, such as salting meat, were no longer needed.

The first of the giant food corporations came to the fore nationally and internationally, and convenience foods, requiring little or no cooking, were heavily promoted (Symons 2007). Typical grocery items for the 1920s family were flour, sugar, rice, sago, tea, tomato soup, spaghetti and baked beans.

Australia's first dietary survey was conducted in 1936–38 and revealed that the average Australian ate about 90.7 kilograms of flour and meat per year, 45.4 kilograms of sugar, 3.2 kilograms of tea, 90.7 kilograms of milk, 13.6 kilograms of butter and 1.8 kilograms of cheese. In comparison with the bush rations of 'Ten, Ten, Two and a Quarter', the flour, meat and tea may have halved but sugar continued to be consumed at similar levels (Symons 2007).

During World War II (1939–1945), the introduction of new laws aimed at increasing the security of the country affected the nation's economy and people's way of life. Rationing of items such as meat, butter, eggs, milk, tea, sugar, beer and spirits was introduced (Clements 1986). Emphasis was placed on living modestly and with austerity. For many who lived through this era and the preceding depression years, emphasis on not wasting food and 'eating everything on your plate' was embedded into their psyche and continued to influence their approach to food in more prosperous times (Wahlqvist 1983).

The end of World War II coincided with a period of economic prosperity for Australia. The war had led to a massive increase in Australia's industrial capacity and post-war these industries quickly adjusted for peacetime production. Wartime investment in scientific research resulted in significant changes to the food industry. Processes such as quick-freezing, continuous process bread-making, chemical extraction of oil from oilseeds and controlled atmospheric storage were introduced. Sliced, white bread became increasingly popular (Symons 2007).





The post-war period also signalled the start of the 'migration revolution' (Table 1.1). As a result, nearly 700,000 immigrants arrived in Australia between 1946 and 1949. This contributed to Australia's economic growth and signalled the beginnings of today's multicultural society (DFAT 2008b). The successive waves of migrants had a significant impact on Australia's eating patterns as new foods and recipes were introduced.

The rise of the supermarkets

Until the 1960s, foods such as bread, milk, vegetables, groceries and meat were often home delivered. However, the advent of the supermarket dramatically changed Australians' food purchases.

In 1958, two large companies (Coles and Woolworths) moved into the grocery business after decades of competing as mass merchandisers of variety goods. These supermarkets began to control food marketing with pre-packaging, bright labels and an emphasis on lower prices. Their preference was to stock long shelf-life, tinned, dried and frozen foods and to source these from suppliers guaranteeing regular deliveries, and consistent quality and prices. This resulted in a trend towards nationally standardised and distributed foods (Symons 2007).

In 1959–60, about 20% of household income was spent on food, and within 5 years this had decreased to about 12%. An ever-increasing number of food items have become available in the supermarket since then; 1,500 in 1950, 8,000 in 1970, 12,000 in 1975 (Symons 2007) and 55,000 in 2010 (FSANZ 2008a). The arrival of big supermarkets coincided with the advent of television and related marketing opportunities, which together considerably influenced Australia's food-buying preferences.

Increase in convenience foods

From the 1970s, Australians' food preferences have changed with less beef and lamb, and more chicken, pork, seafood, fruit, vegetables and grain products being consumed (ABS 1982). There has also been a marked trend towards consumption of convenience foods (packaged food that can be prepared quickly and easily) (Symons 2007).

A handful of large food corporations began to dominate the market, with most being multinational corporations. Sophisticated production methods were introduced to produce new foods, designed by food scientists after extensive market research and then aggressively promoted. In the latter part of the 20th century, television advertising of foods—costing about \$2 million a day in 1980—was almost exclusively for prepared snacks, ice creams, soft drinks and takeaway meals. More frozen foods became available and by 1990 they were a major item in the supermarket trolley (Symons 2007).

The number of dual-income families increased as more women entered the workforce, providing them with more money but less time to spend on preparing food. Other demographic influences affecting food habits included the trend for smaller households, greater ethnic diversity in the community and an ageing population.

Increasing affluence resulted in more meals and snacks being eaten outside the home. The number and variety of restaurants increased, and a wide range of European and Asian cuisines began to influence Australian eating patterns. Fast food chains (quick service restaurants) became increasingly prominent, and by 2007 an estimated 17,000 outlets sold more than 1.64 billion meals and takeaways per year (BIS Shrapnel 2009).

In 1982, the Commonwealth Department of Health issued the first Dietary Guidelines for Australians to promote healthy lifestyles and to minimise the risk of diet-related diseases (Commonwealth Department of Health 1981).



Changes in agricultural practices

In the 20th century, there was also a shift in Australian agriculture, with a move away from the orchardist, market gardener and the traditional 'man on the land' towards more 'agribusinesses'. Frequently this involved large-scale farms with increasing mechanisation and use of pesticides and fertilisers (Henzell 2007). For more information see chapters 2 and 4.

The 21st century

For many families with both parents in employment, modern day life is characterised by working more hours and spending less time preparing food. Meal times are commonly fragmented—people often eat at different times and in different places—frequently outside the home, with a heavy reliance on snack and convenience foods.

Convenience foods have become part of modern day living for people with demanding and hectic lifestyles. The food industry has responded to this demand, with every sector developing some form of new convenience product.

An increasing number of technological advances have changed the way food is produced, manufactured and distributed. Computer-based control systems, sophisticated processing and packaging systems, and logistics and distribution advances have helped to increase efficiencies, ensure product quality, improve food safety and reduce costs (Delforce et al. 2005).

There has been a rise in ethical consumerism, with consumers intentionally buying or avoiding products based on their personal or moral beliefs. For food purchases, this may involve selecting foods that minimise harm to, or exploitation of, humans, animals and the environment. Examples of ethical foods include those produced by cruelty-free, organic or sustainable means, or by fair trade. Conversely, other products believed to be associated with unethical behaviours may be boycotted (DAFF 2004; Heij 2005).

There has been a growing interest in food as a source of entertainment. Television cooking programs have become popular, glossy cookbooks frequently make the bestseller lists and some chefs have become celebrities. Food companies and supermarkets have capitalised on this as a marketing opportunity and have actively promoted their products through these media.

New trends are also emerging, such as the 'slow food' movement that challenges the dominance of standardised, industrially produced food. The movement strives to respect and preserve regional cuisines, along with encouraging traditional farming practices (Galli & Esposti 2012).

1.3 The Australian landscape

Geographical location

Australia has been dubbed the 'island continent' as it is surrounded by the Pacific and Indian oceans and separated from Asia by the Arafura and Timor seas. Its geographical remoteness has been a major factor in influencing the development of its unique flora and fauna and shaping the nation's history and identity.

From the time of European settlement, the size of Australia and the inaccessibility of its interior has led to a concentration of people and infrastructure in the south-east of the country. This pattern has continued today—Australia has a land area of 7.7 million square kilometres (ABS 2008c) and of its 22.6 million people, the majority live in the east and south-east of the continent (ABS 2009b).



About 12 million Australians (53%) live in Sydney, Melbourne, Brisbane and Adelaide (ABS 2011a). Overall, 68% of the population live in *Major cities* and the rest in regional and remote areas (see Box 1.1 for how these are defined). Australia has one of the most urbanised and coast-dwelling populations in the world—more than 80% of Australians live within 100 kilometres of the coast.

Box 1.1: Defining regional and remote areas

This report largely relies on the Australian Bureau of Statistics (ABS) Australian Standard Geographical Classification Remoteness Area classification. The classification allocates one of five remoteness categories to areas depending on their distance from urban centres, where the population size of the urban centre is considered to govern the range and types of services available. Areas are classified as *Major cities*, *Inner regional*, *Outer regional*, *Remote* or *Very remote*. The category *Major cities* includes Australia's capital cities, with the exceptions of Hobart and Darwin, which are classified as *Inner regional*.

Other classifications such as the Rural, Remote and Metropolitan Area classification may be used in other data sources.

Note that areas placed in the same broad categories of remoteness may differ dramatically in their location, economic activities, climate and demography.

Indigenous Australians are over-represented in remote areas. According to the 2006 Census they make up an estimated 32% of the Northern Territory population, with 81% living in areas classified as *Remote* or *Very remote*. Australia-wide, 24% of Indigenous people live in *Remote* or *Very remote* areas (ABS 2006a). In comparison, only 2.3% of all Australians live in these areas (ABS 2008b).

Impact of isolation

Geographical isolation has often affected the price and availability of food, particularly fresh produce in remote areas. Transportation, distribution costs and lack of market competition frequently inflate food prices, creating a barrier to a variety of fresh produce that can subsequently compromise nutritional and health status. Further details of the geographic effect on food selection and intakes are highlighted in chapters 5 and 7.

Climate

Australia experiences some of nature's most extreme weather conditions, including droughts, floods, tropical cyclones and severe storms (ABS 2008c). The climate plays a major role in the food that can be produced across the continent, affecting what can be grown, where and when, as well as how far food needs to be transported to market. In turn, these conditions influence the price and availability of food.

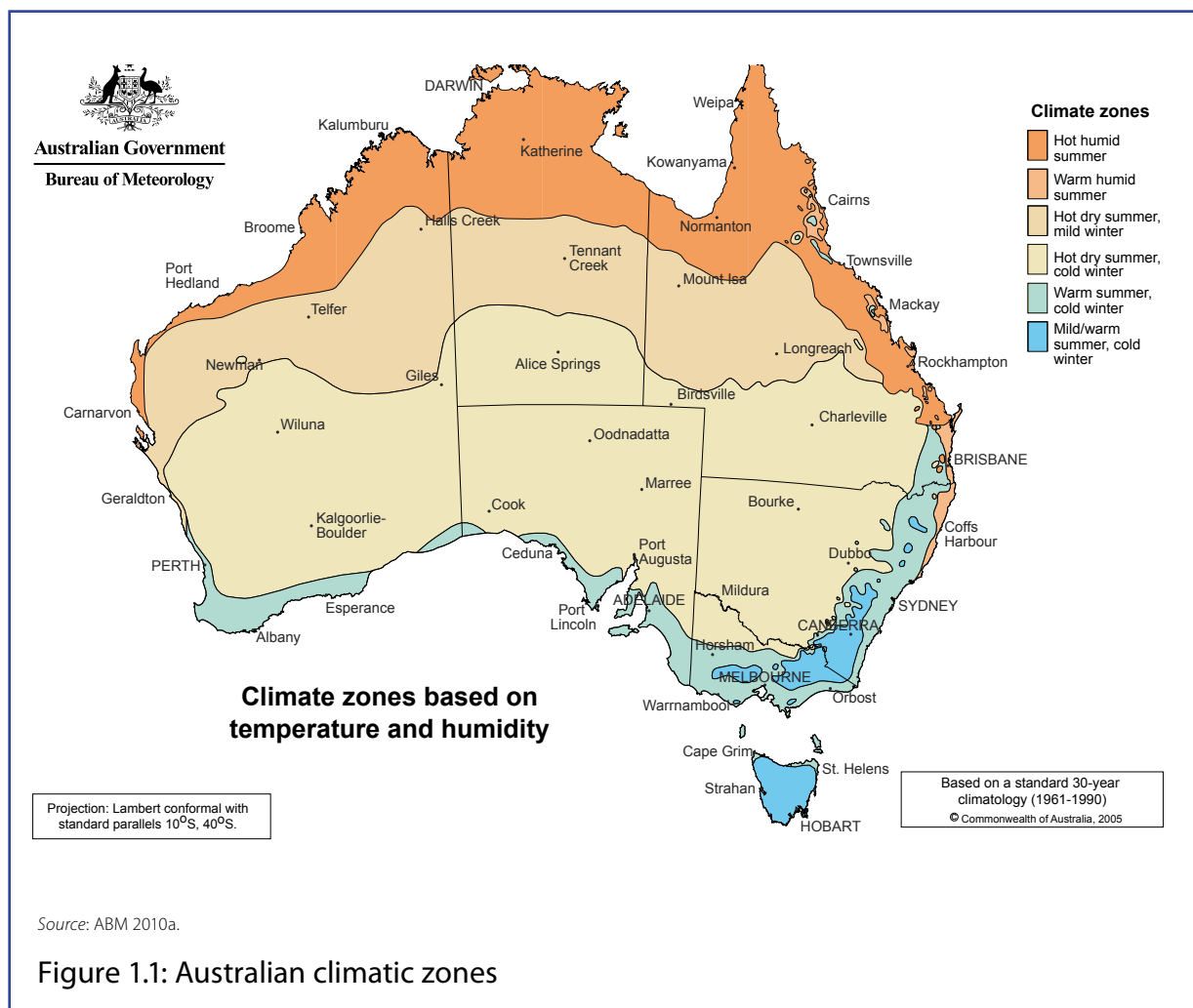
Temperature

Sixty-one per cent of Australia lies in the temperate zone and the remainder in the tropics (Figure 1.1). As such, there are a number of climatic zones: the tropical regions of the north, the arid expanses of the interior, and the temperate regions of the south. Summers are hot through most of the country. Winters are warm in the north and cooler in the south and overnight frosts are common in inland areas south of the Tropic of Capricorn. The elevated areas in the south experience snow during winter (ABS 2008c).





January and February tend to be the hottest months, ranging from an average of 21.8 °C in Hobart to 32.2 °C in Perth. July is the coldest month in all states and territories; however, the range varies considerably, with the lowest average maximum temperature 11.5 °C in Canberra and the highest 30.7 °C in Darwin. There is little difference in the hottest and coldest months in Australia's far north, with Darwin experiencing an average maximum temperature of 33.3 °C in October and November and 30.7 °C in June and July (ABM 2011).



Rainfall

After Antarctica, Australia is the world's second driest continent. The average annual rainfall is below 600 millimetres per year for more than 80% of the continent and below 300 millimetres for more than 50% (ABS 2008c). Average rainfall varies considerably across the country, with about one-third of the continent classed as arid and another third as semi-arid (NLWRA 2001a) (See also 'Water' in the next section).

Of the capital cities, the highest rainfall occurs in Darwin (1,847 millimetres per year) and the lowest in Adelaide (463 millimetres per year). There is no clear seasonal pattern in maximum average rainfall across Australia. Darwin experiences heavy rainfall during the wet season from November to April and virtually no rain during June and July. More rain falls in Brisbane in the summer months than in winter, while there is a fairly even pattern of rainfall throughout the year in Melbourne, Hobart and Canberra (ABM 2011).





Soil and water resources

Soil and water resources underpin Australia's agricultural industry. This in turn provides the nation with a diverse range of produce, contributes significant amounts to export earnings, and employs large numbers of Australians—generating national and regional wealth (DAFF 2012). However, these resources are somewhat limited.

Soil

Australian soils are considered to be ancient, weathered and infertile, due to the lack of volcanic or glacial activity required to renew them (Taylor 1994). Unlike the fertile farming lands of Europe and North America that were renewed less than 12,000 years ago when the glaciers retreated, the most recent volcanic activity in Australia was 10 million years ago in the south-east of the continent (which is relatively fertile).

Australia's vast landscape makes for an array of soil types and climate conditions, which influence how land can be used for food production. These soils have developed in response to environmental factors over 65 million years (climate, landscape, organisms, base material and time). Australian soils have been classified according to their structure and composition, which, together with their location and associated climatic conditions, provide a guide to potential use for food production (McKenzie et al. 2004).

Broadly, soil is classified as sandy (south-west of Western Australia), loam (flood plains in eastern Australia) or clay (south-eastern Australia). In general, these soils contain less organic matter and have poorer structure than soils in the northern hemisphere.

Land degradation exists across large areas of Australia. This has been caused by the natural limitations of soils and their interactions with climate, or by human activity such as over-cropping, which has also led to soil depletion and reduced productivity. Large areas are affected by salt and have a range of nutrient and structural constraints for plant growth and agriculture. In 2005, the National Land and Water Resources Audit identified four priority areas in soil management: wind erosion, water erosion, soil acidification, and soil carbon change (McKenzie & Dixon 2006).

Wind erosion

Wind erosion removes the nutrient components of soils and is predominant in dry environments, such as Australia. Due to the low fertility of Australian soils, any further reduction will affect the productivity of crops and competitiveness in the export market (McKenzie & Dixon 2006).

Water erosion

Water erosion occurs predominately in landscapes with high rainfall intensity or steep slopes. This has affected the shallow stony soils that cover much of Australia's coastal ranges and steeper semi-arid lands. In addition, the risk of sheetwash erosion, when a mobile sheet of water removes the surface soil, is further increased when the protective vegetation cover is removed or degraded by clearing, tillage or overgrazing. Water erosion causes loss of fertile topsoil and associated water-holding capacity and nutrients, reducing agricultural productivity (NLWRA 2001b).

Soil acidification

Acidification affects half of Australia's agriculturally productive soils and is a major contributor to decreasing plant yields. Acidic soils are more prevalent where annual rainfall exceeds 500 millimetres. These soils are predominately concentrated in a band extending from the Central Tablelands of New South Wales, through central Victoria into south-eastern Australia. The agricultural zone of Western Australia is also affected. Adding lime to the soil is an initiative to reduce soil acidity but, if not corrected, acidification can cause irreparable damage (NLWRA 2001b).



Soil carbon change

Organic matter plays a critical role in a number of soil processes and functions, including soil structure and stability, nutrient cycling processes and water-holding capacity. Soil organic carbon is the largest component of soil organic matter and its concentration is a useful indicator of soil condition that sustains plant productivity (McKenzie & Dixon 2006). As well as protecting against erosion and improving soil fertility and crop yields, increasing the organic carbon content of soil has the potential to store carbon and reduce the impact of climate change.

Monitoring of soil conditions

Long-term monitoring of soil conditions across Australia has been recommended to inform the current status of soil processes that could affect Australia economically, environmentally and socially. However, in recent times, soil management has been overshadowed by seemingly more pressing issues like climate and water. As a result, there has been a loss of focus on knowledge, people, systems and agencies dedicated to soil management in Australia (Campbell 2008).

Water

The single most important feature shaping land use in Australia is rainfall, or lack of it. Nearly one-quarter of Australia's 769 million hectares is desert and not used for commercial farming. Historically, settlements were established near reliable water supplies, leading to Australia's population being concentrated near the coast.

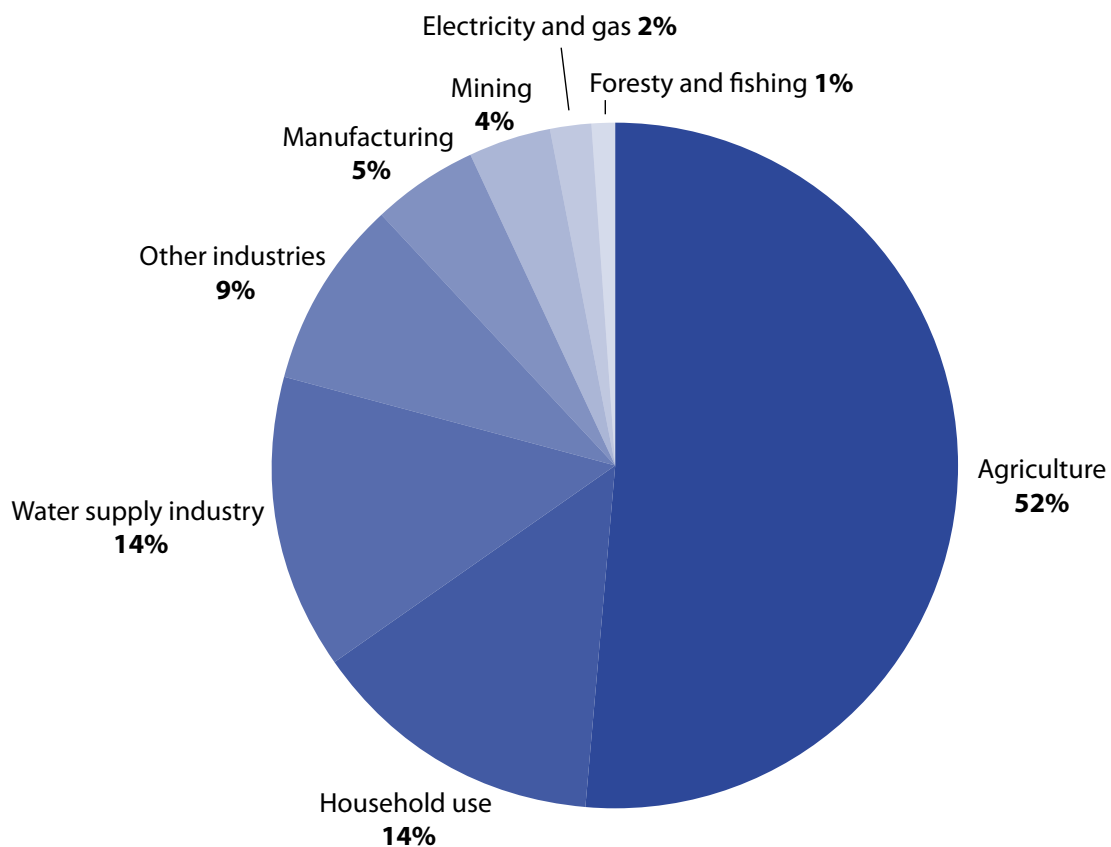
The establishment of irrigation schemes, largely by government, helped the expansion of populations to parts of inland Australia. The discovery of the Great Artesian Basin also allowed the pastoral industry to develop dry inland grazing country.

Water usage

In Australia the availability of water varies greatly. Any assessment of water supply and use over time must take this variability into account. The latest assessment was done by the ABS in 2009–10 (ABS 2011b). It showed that Australia's total water use was about 64,000 gigalitres (1 gigalitre is about the amount of water in 500 Olympic swimming pools). More than 80% of the water was known to have been returned to the environment.

Nationally, water used for 2009–10 (water not returned to the environment) was 13,500 gigalitres, with the agricultural sector accounting for 52% of water consumption (Figure 1.2). Of the water used by agriculture, most is for irrigating crops and pastures, but large amounts are not used as efficiently as they could be. For example, up to 20% of irrigation water can be lost in farm distribution channels. In addition, a further 10–15% of water applied to crops may be lost due to over-watering as a result of high volume, gravity irrigation methods (DEWHA 2009).





Source: ABS 2011b.

Figure 1.2: Water consumption by the different sectors of the Australian economy, 2009–10

Agriculture is generally limited to parts of the continent because it requires good quality, higher rainfall landscapes. It is also important for the Australian farming system to efficiently use natural rainfall and maximise efficient use of irrigation water supplies to provide a more secure source of water for agriculture (NLWRA 2001b).

Land use

In 2009–10, just over half (52%) of Australia's total land area was managed by agricultural businesses, such as grazing, cropping and horticulture (Table 1.3). The lowest proportion was in Tasmania (24% of the state's area) and the highest in Queensland (75%). The primary use of agricultural land was for animal grazing (88%), with the highest proportion in the Northern Territory (98%) and the lowest in Victoria (57%). The proportion of agricultural land used for crops was 8%, ranging from less than 1% in the Northern Territory to 37% in Victoria. Some of the balance of agricultural land was used for forestry plantation and conservation zones (ABS 2011c).



Table 1.3: Estimated land utilisation in Australia, 2009–10 ('000 hectares)

	NSW ^(a)	Vic	Qld	WA	SA	Tas	NT	Aust
Total area under agriculture	58,588	12,852	129,668	94,391	45,747	1,647	55,687	398,580
Percentage of total land mass	73.0	56.5	74.9	37.3	46.5	24.1	41.3	51.8
Percentage of agricultural land used for crops ^{(b)(c)}	16.1	36.9	2.5	11.1	11.3	8.8	–	8.3
Percentage of agricultural land used for grazing ^(c)	79.1	56.8	93.9	85.7	84.6	71.1	97.6	87.9

(a) Includes ACT.

(b) Includes land used for broadacre crops and horticulture.

(c) Land use areas as a percentage of area of agriculture holding.

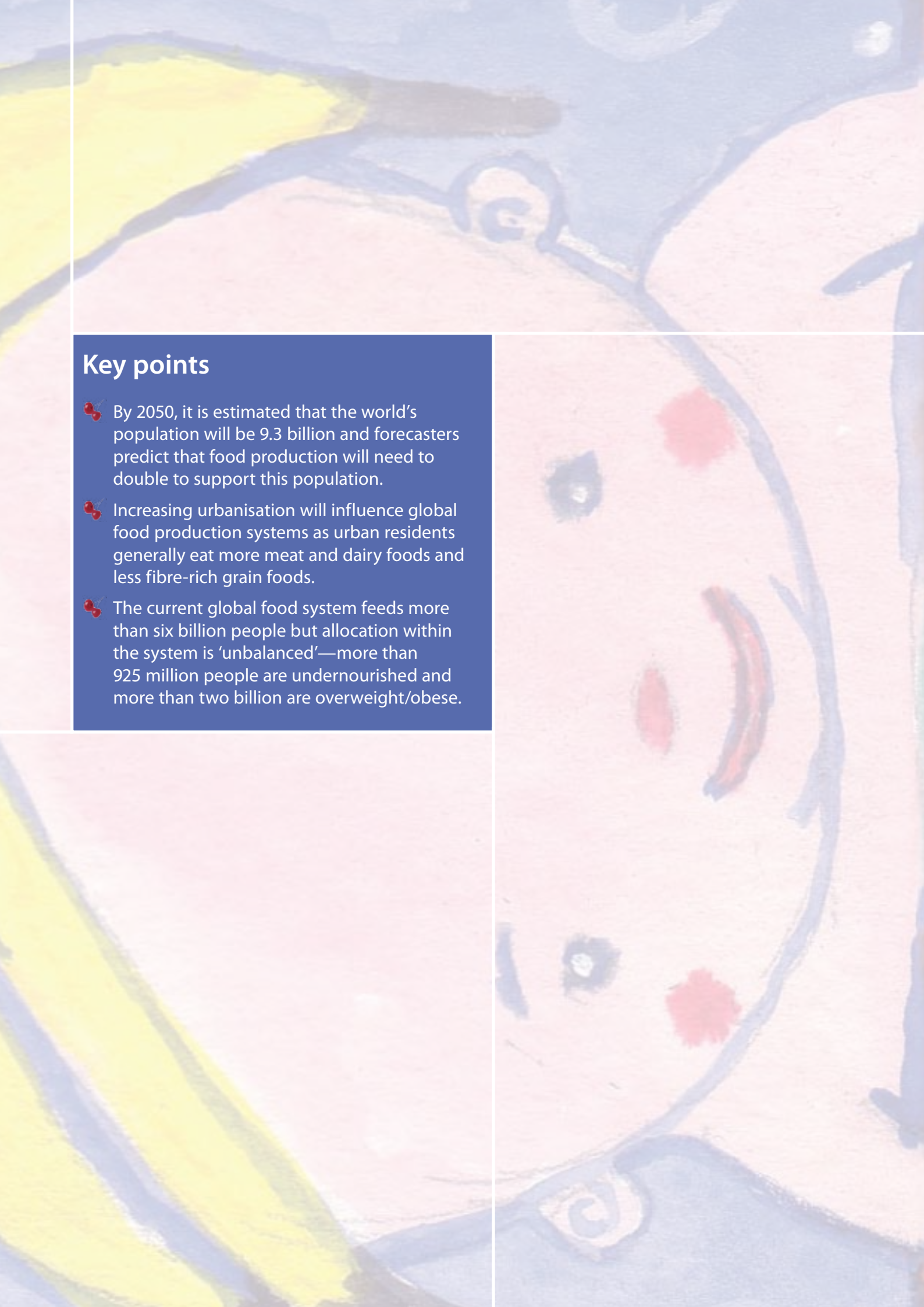
Source: ABS 2011c.

Since European settlement, the Australian environment has been considerably altered by agriculture, mining, forestry, industry and urbanisation. In terms of area, agricultural and pastoral activities have had the greatest influence on the environment. Available arable land is continuing to decrease as a result of land degradation, urban expansion and water quality, raising concerns for the future effect this will have on the Australian food supply (PMSEIC 2010).

Due to Australia's variable rainfall and frequent extreme weather events, any increases in temperatures or changes to climatic patterns could have detrimental effects on food production (IPCC 2007a; Gunasekera et al. 2008). The impact of climate change is likely to vary between regions and climatic zones, so there is a high degree of uncertainty around changes to agriculture and food production. The potential effects of climate change are discussed in Chapter 2.



1 People and their environment

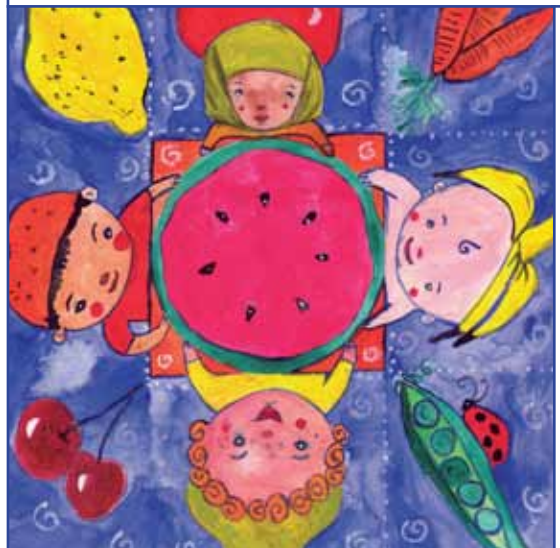


Key points

- By 2050, it is estimated that the world's population will be 9.3 billion and forecasters predict that food production will need to double to support this population.
- Increasing urbanisation will influence global food production systems as urban residents generally eat more meat and dairy foods and less fibre-rich grain foods.
- The current global food system feeds more than six billion people but allocation within the system is 'unbalanced'—more than 925 million people are undernourished and more than two billion are overweight/obese.

The global food system

2.



2.1 Historical context

During the past two centuries, the food supply system, particularly in developed countries, has been fundamentally transformed. Major influences include public health concerns regarding food security, the Green Revolution (Box 2.1), advances in technology, increasing globalisation and demographic changes.

Box 2.1: The Green Revolution

From the 1940s to the 1970s, the Green Revolution transformed agricultural practices around the world. As a result, agricultural outputs dramatically increased, largely due to improved crop varieties, expansion of irrigation infrastructure, new technologies, synthetic fertilisers and pesticides. During this period, cereal production more than doubled in developing countries (FAO 2011a).

At the beginning of the 20th century, nutrition-related conditions such as anaemia and stunting were common in many industrialised countries, mainly due to poverty. Intakes of meat and milk were shown to promote growth in children and consumption of butter, fats and sugars to increase their weight. These findings helped reset global agricultural and food priorities and policies, many of which still dominate in the world today. The main response was to raise food outputs and reduce prices. Subsidies were provided to farmers to increase the production of meat, milk, butter, oils and sugar, contributing to national food security (James 2006).

Growth in international telecommunications, food transport and trade has led to major changes in the food supply system. Advances in food processing, manufacturing, retailing and distribution systems allow foods to be available across all seasons and to be transported throughout the world (McCullough et al. 2008).

Due to rising incomes, increasing urbanisation and ageing populations, diets of not only the developed world, but also in parts of the developing world, are changing substantially. There has been a shift to more diverse diets containing more fresh produce, animal products and processed foods. This has occurred at the expense of staples, such as grains. Coinciding with these changes, food prices, in real terms, have declined to their lowest levels in history and consumers can now purchase more kilojoules than ever before (Schmidhuber & Shetty 2005).

However, not all countries have benefited from these changes to the global food supply, particularly parts of the developing world, such as sub-Saharan Africa. There are now increasing calls to rethink the way food systems currently operate to respond to the already apparent and future challenges of population growth, chronic disease, climate change, social inequality and environmental sustainability (Lang & Heasman 2004; Lang 2009; PHAA 2012).

2.2 Population growth and distribution

Between 1950 and 2010, the world's population increased from 2.5 billion to 6.9 billion, with 37% of people now living in China and India (UN Department of Economic and Social Affairs Population Division 2011). During this time, the proportion of the world's population living in less developed regions, increased from 68% to 82%, and this trend is likely to continue (Figure 2.1).



By 2050, the world's population is estimated to reach 9.3 billion, and Australia's population 34 million (ABS 2008d). Currently, Africa is the fastest growing region and it is estimated that it will account for 24% of the world's population by 2050, and 35% by 2100. In contrast, the proportion of the population living in more developed regions (such as Australia) is projected to drop from 18% in 2010 to 13% in 2100 (UN Department of Economic and Social Affairs Population Division 2011).

Forecasters predict that food production will need to double by 2050, without a corresponding increase in land and water inputs. As a result, addressing energy and water issues will be critical to meet the future world food demands for a growing population (Campbell 2009).

As of 2011, more than half of the world's population live in urban areas (Box 2.2). This represents a significant shift from the 1950s when the figure was less than 30%. Although most people now live in urban settings, the majority reside in small towns rather than large cities. Just over a third of the population (39%) live in cities of more than one million residents and only 1 in 10 in megacities of more than 10 million (UN Department of Economic and Social Affairs Population Division 2012) (Figure 2.2).

Box 2.2: What is an urban area?

One way of reporting population growth, for planning and development purposes, is to measure populations living in rural or urban areas. When the United Nations compiles global urbanisation statistics, it does not use one definition of urban for all countries. Instead, it uses the definition used in each individual country—normally defined during the country's censuses.

For example, Australia defines urban areas as areas with a population of 1,000 or more (ABS 2012b), while Peru defines urban as 'Populated centres with 100 or more dwellings' (UN 2012).

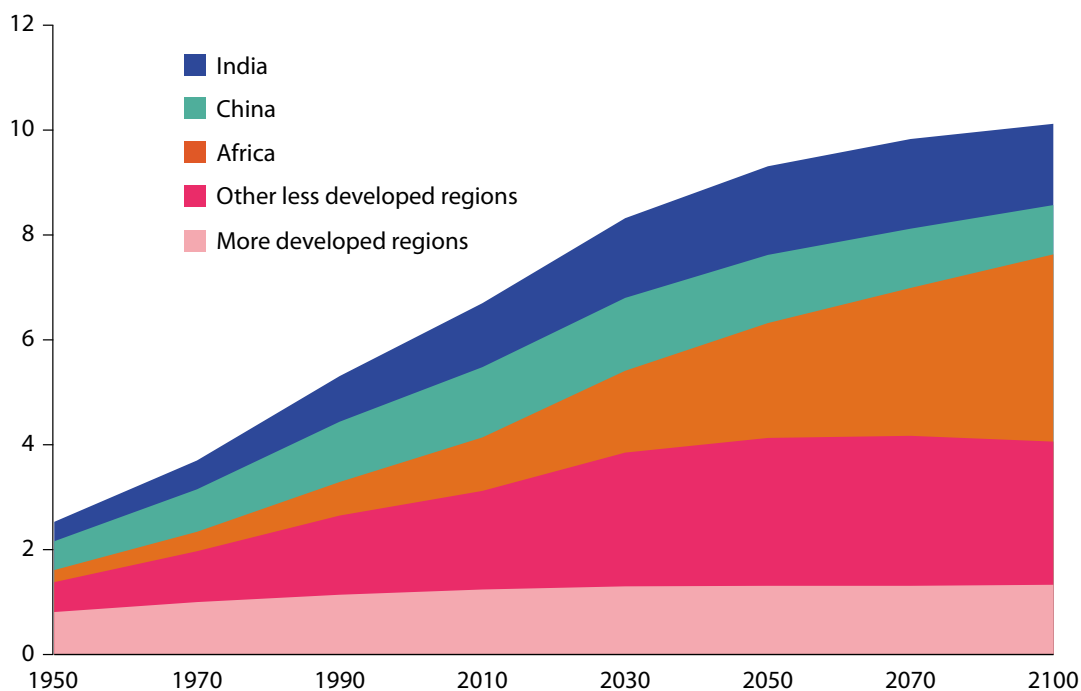
If urban area definitions change between censuses, adjustments are made to ensure consistency over time.

Increasing urbanisation is likely to influence the nature of global food production. Urban residents tend to have higher per capita income, access to a wider variety of food, and women are more likely to be in paid employment than their rural counterparts. Globally, urban dwellers generally eat more meat, fruit and vegetables, whereas rural dwellers eat more cereals, tubers and roots (Regmi & Dyck 2002).



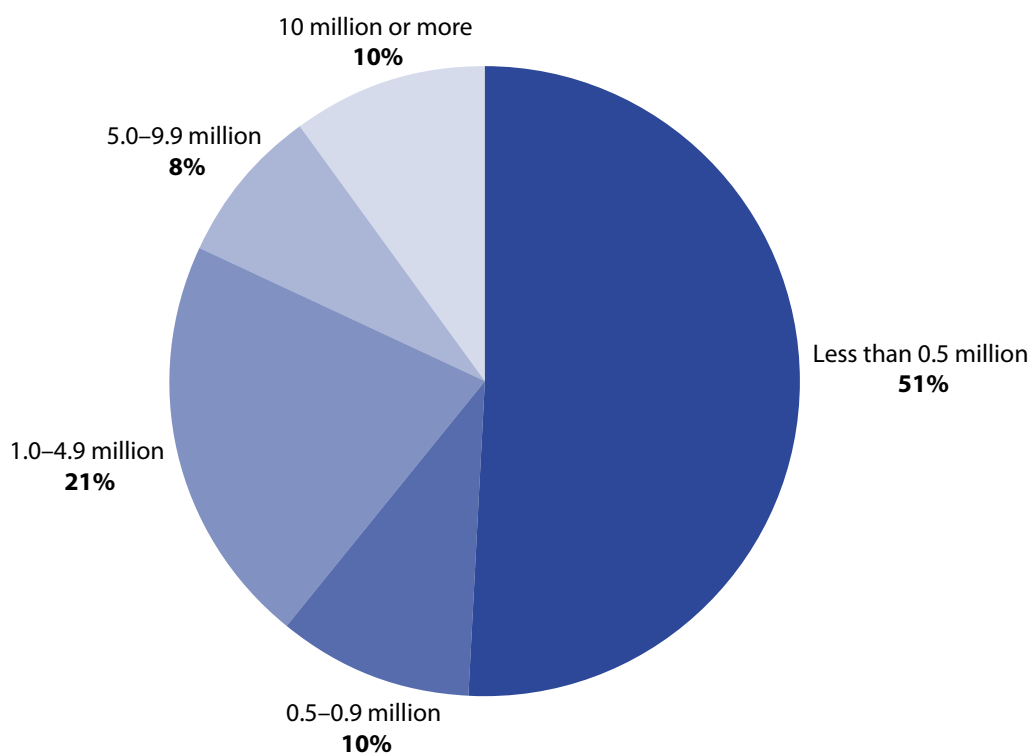


Population (billions)



Source: UN Department of Economic and Social Affairs Population Division 2011.

Figure 2.1: World population growth, 1950–2100



Source: UN Department of Economic and Social Affairs Population Division 2012.

Figure 2.2: World population distribution by urban size, 2011





2.3 Global food security

The UN's Food and Agricultural Organization (FAO) states that food security exists 'when all people, at all times, have access to sufficient, safe and nutritious food to meet their dietary needs for an active and healthy life' (FAO 1996). It is a function of food availability (dependent on natural and human resources), food accessibility (dependent on purchasing power or access to fertile land) and food utilisation (nutritional uptake) (Ericksen 2008).

The increases in agricultural yields over the past 40 years have largely been driven by greater inputs of fertilisers, water, pesticides, new crop strains and other technologies of the Green Revolution (Tilman et al. 2002). Since the 1950s, world beef and mutton production has more than doubled, world grain production has tripled and oceanic fish catch has more than quadrupled. At the same time, world fertiliser usage rose from 14 million tonnes in 1950 to 141 million tonnes in 2000 (Brown 2001).

In theory, the world currently produces enough food (in terms of kilojoules) to sufficiently feed the entire population, provided it is distributed equitably. Despite a 70% increase in the population, the world's food system generates 17% more energy per person today than it did 30 years ago. The amount of food produced could supply each person on earth with at least 11,300 kilojoules per day (FAO 2002). Despite this, there are more than 925 million people without access to sufficient food, mainly due to poverty (FAO 2010). In contrast, there are more than 1.6 billion people who are overweight and at least 400 million who are obese (WHO 2006).

The increasing proportion of overweight and obese people also increases world food demands. If all countries had similar levels of overweight and obesity as countries like the United States and Australia, the extra food required would feed another half a billion people (Walpole et al. 2012).

Under-nutrition and poverty

Under-nutrition and poverty are inextricably linked and are 'one of the greatest challenges of our time' (UN Development Group 2010). The United Nations Millennium Declaration, signed in September 2000, committed world leaders to combat poverty, hunger, disease, illiteracy, environmental degradation and discrimination against women. In an effort to halve world poverty by 2015, all 191 member countries of the United Nations, including Australia, committed to eight Millennium Development Goals (Box 2.3). These goals have specific targets and indicators that underpin Australia's aid program.

As part of the Millennium Development Goals report, the World Bank determined that US\$1.25 a day was the minimum level of income necessary to achieve an adequate standard of living. To date, there has been some progress in reducing the number of people living in poverty but this has slowed due to the global economic and financial crisis that started in 2007 and is ongoing. This crisis has prompted a decline in global exports, commodity prices and reduced trade and investment. As a result, growth in developing countries has slowed. Despite this, the number of people in developing regions living on less than US\$1.25 a day decreased from 1.8 billion in 1990 to 1.4 billion (22% of the world population) in 2005 (UN 2010a).

Economic growth in developing regions is considered strong enough to sustain progress on the poverty reduction target and, as a result, the number of people living on less than US\$1.25 a day is expected to fall to 920 million (15%) by 2015 (UN 2010a).



Box 2.3: Millennium Development Goals

- Goal 1: Eradicate extreme poverty and hunger^(a)
- Goal 2: Achieve universal primary education
- Goal 3: Promote gender equality and empower women
- Goal 4: Reduce child mortality rate
- Goal 5: Improve maternal health
- Goal 6: Combat HIV/AIDS, malaria, and other diseases
- Goal 7: Ensure environmental sustainability
- Goal 8: Develop a global partnership for development

(a) Hunger is measured as the proportion of the population who are undernourished and the prevalence of children under 5 who are underweight.

Over-nutrition

Governments are becoming increasingly concerned about levels of obesity, associated chronic diseases and escalating health costs, which are partly driven by diets high in overall energy (WHO 2000). Over-nutrition (in the form of overweight and obesity) now competes with tobacco smoking as a major contributor to national and international ill health (Scarborough et al. 2011). The role of the modern industrial food system in human health is under question and there are increasing calls for an urgent resetting of agricultural and food chain policies and practices (James 2006).

From the Australian perspective, at the population level, the balance of under- and over-nutrition is skewed towards over-nutrition. Of the 34 member countries in the OECD, Australia ranks fifth for the proportion of the population who are obese (25%). In many countries, such as Australia, those that are obese or overweight are not exclusively food secure. See chapters 5 and 8 for further details.

Not only is obesity a problem in developed countries, but it is increasingly becoming a problem in developing countries. As countries become more prosperous, there is a shift in eating and physical activity patterns, characterised by people eating more fat, sugar and processed foods, and becoming more sedentary. Eight out of the 10 countries with the greatest increases in obesity rates are developing or newly industrialised nations. In countries such as China, Mexico, Thailand, Brazil and Morocco, obesity is increasing faster than in the United States (Popkin & Gordon-Larsen 2004). Paradoxically, some countries, like Bangladesh, are experiencing increased rates of obesity and yet are still struggling with high rates of under-nutrition (Gill 2006).

In recognition of the growing burden of non-communicable diseases, international efforts have been devised to promote a healthy diet and physical activity. The WHO Global Strategy on Diet, Physical Activity and Health calls on nations to support food and agriculture policies, marketing campaigns and education programs to encourage healthy eating and promote physical activity. The strategy recommends limiting fat, sugar and salt in the diet and increasing the consumption of fruits, vegetables, legumes, whole grains and nuts.



2.4 Global food production system



The food system is a heavy component of the human environmental footprint on the planet. If current trends in human population and consumption patterns continue, the world will need to produce about twice as much food by 2050, in a rapidly changing climate, with declining production of oil and rising prices for energy, water, fertilisers, and soon, carbon. The era of abundant, cheap fossil fuels is over. Traditional avenues of expanding production through clearing, irrigating and cultivating more land are narrowing, and food is now competing with energy for land and water resources (Campbell 2009).

The world's food supply system is facing many challenges and these may impinge on long-term global food security. Overall, Australia is a food secure nation, and a net food exporter (see Chapter 4); however, food imports are steadily increasing (DAFF 2012).

Energy

Global food production is highly dependent on cheap energy, particularly fossil fuels, to produce, process and distribute food. Energy costs are a significant cost component for fertiliser, farming and food distribution. As fuel costs rise, due to diminishing reserves and increasing extraction costs, this will likely translate into higher food costs. The introduction of future carbon management schemes, such as in Australia in 2012, may affect food costs due to greenhouse gas emissions associated with fossil fuel usage in the food production chain.

As fossil fuels become more expensive, alternative energy sources, such as biofuels, become more viable and cost competitive. As a consequence, there is increasing competition for agricultural land and resources to produce commodities, such as corn, sugar cane and palm oil, for use as biofuels. Biofuel production has increased in recent years. For example, one-quarter of the United States corn harvest in 2007 was diverted towards biofuel production. This is believed to have contributed to increased cereal prices and ultimately food prices (Brown 2007). In 2008, there were protests and riots over the increasing cost of food in many countries, including Pakistan, Guinea, Mauritania, Mexico, Senegal, Uzbekistan, Yemen and Indonesia (Magdoff 2008).

Due to concerns of biofuels diverting food from human consumption and affecting food security, there have been efforts to produce second generation biofuels from non-food crops, crop residues and waste. These second generation biofuels could potentially combine farming for food and fuel and help mitigate threats to global food security (US Department of Energy 2010).



Water

Having access to safe and sufficient water and sanitation is now recognised a basic human right. Without access to clean water, soap and sanitation, chronic waterborne diseases spread within and across communities. In turn, without healthy, disease-free bodies, people cannot optimally absorb nutrients consumed in food. Despite this recognition, 2.5 billion people lack access to sufficient sanitation facilities, and more than 780 million people still use unsafe drinking water sources (WHO & UNICEF 2012). There are increasing concerns over the future availability of clean, fresh water due to rising competition between households, industry and agriculture. The demand for water is expected to increase in all regions of the world. It is estimated that achieving the Millennium Development Goal of reducing world hunger will require a 50% increase in water use by agriculture by 2015, and a doubling by 2050 (SEI 2005).

Although the planet is a water-rich environment with more than 70% covered in water, only 3% is fresh water, with just over two-thirds frozen in glaciers and polar ice caps. Despite fresh water being a renewable resource, the world's supply of clean, fresh water is steadily decreasing. Water demand already exceeds supply in many parts of the world and as the world population continues to rise so, too, does demand.

In some parts of the world, water use already exceeds the amounts that are naturally replenished every year. The United Nations defines moderate-to-high water stress as 'water consumption that exceeds 10% of renewable freshwater resources'. Based on this measure, by the mid-1990s, about 80 countries, representing 40% of the global population, were experiencing water shortages (Gleick 2009).

By 2050, the United Nations Environment Programme estimates that '1.8 billion people will be living in countries or regions with absolute water scarcity, and two out of three people in the world could be living under conditions of water stress' (UNEP 2007). As a result, food prices and health threats are likely to increase, with poorer countries being disproportionately affected.

Agriculture accounts for 70% of freshwater withdrawals from rivers, lakes and underground sources and most of this is used for irrigation. Since 1961, the amount of irrigated land has increased from 139 million hectares to 275 million hectares. This represents 20% of all cultivated land and provides more than 40% of the world's food (UNEP 2007).

Increasing water withdrawals for irrigation also increases the risk of salinity. As ground water levels rise, dissolved salts that have been stored in the ground for millennia are brought to the surface. This makes the land unusable for agriculture and is a major problem in grain-growing areas in many countries, particularly in Australia and Africa. Globally, about 20% of irrigated land is salt-affected (UNEP 2007).

To ensure sufficient water for the future, it will be important to develop sustainable agricultural systems that promote effective use of water resources, including:

- improving water conservation and storage
- plant breeding for the selection of drought-tolerant crop species
- maximising the efficiency of irrigation systems
- improving the capacity of soils to retain moisture
- minimising the pollution of water systems.

The concept of 'virtual water' has been introduced to account for the water embedded either in the food itself or in other products needed for the production of this food. For example, the production of 1 kilogram of wheat requires about 1,000 litres of water, whereas for meat-based foods about 5 to 10 times more water is required (SEI 2005).



Within the Australian context, despite being one of the driest countries in the world, Australia is one of the largest net exporters of virtual water. Much of the water used to grow crops, such as wheat, rice and cotton, is exported. Additionally, yearly rainfall variability, poor water run-off, an increasing demand for water, and an unbalanced distribution of water use make this a greater issue. For example, despite having only 6% of Australia's surface water run-off, the Murray-Darling Basin accounts for more than 50% of Australia's freshwater use (National Water Commission 2007). In response, the Australian Government's initiative, Water for the Future, now provides long-term national leadership in water reform to secure Australia's water future (DEWHA 2010a).

In developing future food and nutrition policies, it will also be important to consider food consumption patterns that support sustainable water resource management. In theory, encouraging people to eat fewer meat-based foods and more plant-based foods could help reduce the environmental costs of the global food system (Friel et al. 2008; PHAA 2012).

Phosphorus

Phosphorus is crucial to the world's food supply system. Together with nitrogen and potassium, phosphorus is an essential nutrient for crop and animal growth. Over the past 60 years, farmers have extensively used phosphorus-rich fertilisers, obtained from mining phosphate rock, to increase their crop yields. The use of these fertilisers helped fuel the Green Revolution, doubling crop yields and making it possible to feed an additional 4.2 billion people since the 1950s (IFPRI 2002). Modern agriculture is highly dependent on regular inputs of phosphate fertiliser (Cordell et al. 2009). As population growth increases, diets are trending towards more phosphorus-intensive meat- and dairy-based foods, and phosphorus-deficient soils persist in many parts of the developing world; therefore, the need for phosphorus-rich fertilisers is also expected to increase.

However, world reserves of high-grade phosphate ore are progressively being depleted and production costs are increasing. It is estimated that phosphate extraction may peak as early as 2030, after which time global food security may be constrained not only by limited oil and water supplies, but also from limited phosphorus stores. Likely effects include rising food prices, growing food insecurity and widening inequalities between rich and poor countries (Cordell et al. 2009).

Nearly 90% of the world's phosphate reserves are found in just five countries: Morocco/Western Sahara, Iraq, China, Algeria and Syria, with 70% under the control of Morocco alone (U.S. Geological Survey 2012). As fertiliser prices increase, this is likely to have major geopolitical consequences (Ulrich et al. 2009).

Unlike fossil fuels, phosphorus can be captured from waste streams and recycled as a form of renewable fertilisers. As this element does not decompose, it is theoretically available somewhere on the earth, but extracting it is likely to become increasingly costly. Although the global population consumes about 3 million tonnes of elemental phosphorus from food, about five times this amount is mined for food production (Cordell et al. 2009). This is because large amounts of phosphorus are currently being lost throughout the food supply chain—from mine, to paddock, to plate.

Australia has naturally phosphorus-deficient soils and previously relied heavily on imported phosphate from the Pacific island of Nauru and domestic sources to help support its production of beef, sheep and wheat (Cordell & White 2010). In Nauru, phosphate production began to decline in the late 1980s and ceased altogether in 2003 (DFAT 2011). Today, Australia depends on imports for 50% of its fertiliser demand (largely from Morocco/Western Sahara). Like virtual water, Australia is also a net virtual exporter of phosphorus from the food system (Cordell & White 2010). Only 5% of phosphorus fertiliser used in agriculture ends up in the food Australians eat. The remaining 95% is lost as waste at all stages of the food system, or exported off our shores as agricultural commodities or fertilisers.





Australia's phosphorus requirements are likely to increase in the future due to continuing population growth, the global demand for more meat-based diets and the continuing need to address soil deficiencies. Options for increasing phosphorus availability and accessibility and hence the resilience of the food system (in Australia or elsewhere) include: increasing the efficiency of phosphorus use, investing in renewable fertilisers, and managing phosphorus use together with other resources—such as energy and water—to identify positive synergies and avoid competing resource use (for example, certain biofuels can affect phosphorus sustainability by either increasing the demand for fertilisers to produce biofuel crops, or removing valuable phosphorus in crop/organic waste from the food system) (Cordell et al. 2011).

Land use

Human food production is highly dependent on arable soil and historically people have settled in areas with fertile soils. Yet, fertile lands for food production are diminishing due to increasing urbanisation and land being increasingly diverted for biofuel production and mining. Although towns and cities occupy only a small fraction of the land surface, their demand for food, water, raw materials and waste disposal sites dominate the surrounding lands (UNPF 2007).

Increases in farm and forest products have generated greater wealth and security for many people. However, this has often resulted in environmental costs, such as land degradation, loss of biodiversity and disruption of biophysical cycles, such as water and nutrients (UNEP 2007).

Land degradation, a decline in land quality caused by human activity, includes soil erosion, salinisation, nutrient depletion and desertification (transformation of arable land into desert). Due to different definitions and terminology, it has been difficult to accurately quantify the extent and rate of land degradation. Despite this, it is generally recognised that rates of land degradation are increasing in both the developed and developing world (Oldeman, 1994; Chen et al, 2002).

The major causes of land degradation include:

- urban sprawl and increasing population growth
- land clearance of forests and savannas
- poor farming practices leading to a depletion of soil nutrients
- overgrazing of livestock
- land pollution, including industrial waste
- inappropriate irrigation
- mining.

The continuing loss of arable land is likely to pose a potential threat to future world food security and the environment. Policies and mechanisms that prevent further land degradation will become increasingly important to ensure sustainable food production.





Biodiversity



Biodiversity, the variety of life on Earth, is essential to sustaining the living networks and systems that provide us all with health, wealth, food, fuel and the vital services our lives depend on (UN 2010b).

Modern agriculture has focused on just a few plant varieties intended for intensive farming. Although 250,000 plant varieties are available for agricultural purposes, fewer than 3% are in use today. As a result, this has dramatically reduced the diversity of plants contributing to food supplies. This trend is known as 'genetic erosion' (FAO 2008).

The loss of biodiversity occurring in food and agricultural systems is a risk to future world food security. Fewer than 20 animal and plant species now provide most of the world's food and just three crop plants, wheat, rice and maize (corn), supply more than half of the world's food energy (FAO 1995).

Agricultural systems with low genetic variation are more susceptible to pests and diseases and are also less able to adapt to environmental challenges, such as climate change and water scarcity. As biodiversity declines, the food supply becomes more vulnerable and unsustainable, as exemplified by the Irish Potato Famine in the mid-1800s (Box 2.4).

Box 2.4: A blight on potato production

In the mid-1800s, the Irish Potato Famine devastated Ireland's population and economy. Although the famine had many causes, the lack of genetic variation in Irish potatoes contributed to the severity of this disaster.

During this time, the potato was the staple crop for the poorest regions in Ireland and for more than three million people was their only significant food source. Farmers relied heavily on one main variety of potato, the 'lumper', as it was highly fertile and produced greater yields than other varieties. These potatoes were mostly propagated vegetatively, a form of asexual reproduction that produces genetically identical clones. As a result, lumpers were low on genetic variation and therefore more vulnerable to changing environmental conditions (University of California Museum of Paleontology 2011).

In 1845, a plant disease commonly referred to as potato blight spread rapidly through the poorer communities of western Ireland and caused massive crop failures. This disease, caused by the fungus *Phytophthora infestans*, turned susceptible potatoes into inedible slime. As a consequence, about one million people died of starvation and more than one million emigrated. The population decreased by 20–25% and the famine resulted in permanent changes to Ireland's demographic, political and cultural landscape (Donnelly 2011).

There is increasing recognition of the need to promote sustainable agricultural practices to address environmental and food security concerns. When examining agricultural biodiversity, it is important to consider not only the species for production, such as crops and livestock, but also those that support food production, such as soil microbes and pollinators.





In attempting to conserve biodiversity for long-term food security, it is important to consider three levels of diversity:

- genetic diversity—the variation of genes within species that provide the raw material for evolution and adaptation
- species diversity—the number of species within a habitat
- ecosystem diversity—the variety of ecosystems within a given place.

Biodiversity is threatened not only when species become extinct, but when the dynamics of ecosystem functions and processes are disturbed. Factors contributing to loss of biodiversity include habitat destruction, pollution, climate change, introduction of exotic species, and unsustainable harvesting of natural resources. For example, marine biodiversity has been affected by overharvesting of the world's fish stocks (Box 2.5).

Box 2.5: Depletion of world fish stocks

Over the past 50 years, global fish stocks have fallen considerably, with more than 70% of the world's fish species now either fully exploited or depleted (FAO Fisheries Department 2005). About 90% of all large fish, such as sharks, swordfish, tuna and marlin, have disappeared from the world's oceans, largely as a result of industrial fishing (Myers & Worm 2003).

Over-harvesting of certain fish species is occurring at an alarming rate. Unlike domesticated animals bred for consumption, certain species are not being given the opportunity to replenish their numbers. With modern technologies such as acoustic equipment and global positioning systems now being used to harvest fish, they have less chance of evading capture (Pauly 2006).

More than 200 million people rely on fishing and aquaculture for their income and one billion people rely on fish as their main source of animal protein (World Bank Agriculture and Rural Development Department 2004). Since 1960, it is estimated that marine biodiversity has decreased by as much as 29% (Worm et al. 2006). Forecasters predict that the ocean's supply of seafood could be depleted by as early as 2048. A concerted effort is needed to restore marine biodiversity through sustainable fisheries management, pollution control, maintenance of essential habitats and the creation of marine reserves.

Climate change

Climate change refers to the long-term change in the statistical distribution of weather patterns over extended periods, ranging from decades to millennia, and global warming refers to the rise in the average temperature of the earth's atmosphere and oceans.

Evidence for global climate change is growing, with increases observed in global average air and ocean temperatures, rising sea levels, and melting of snow and ice (IPCC 2007b; Garnaut 2008; Garnett 2008). The scientific consensus is that human activities, particularly those associated with emissions of greenhouse gases (such as the burning of fossil fuels) are a primary contributor to these environmental changes. In response to the weight of evidence, many international institutions have proposed strategies that aim to mitigate or adapt to the effects of climate change.

Agriculture and food production are human activities closely tied to climate change. Despite advances in modern farming practices, weather and climate are still major factors in determining agricultural productivity.





The impact on food production

As many of the future effects of climate change are unknown, they cannot be systematically evaluated. As such, a degree of uncertainty surrounding changes to agriculture and food production exists. Further, the impact of climate change will vary between regions, climatic zones and thus agricultural sectors.

The global food supply relies on fertile soil, a stable climate and freshwater supplies, among other factors (McMichael et al. 2008). These important variables all have the potential to be adversely affected by climate change.

Temperature

Increasing global temperatures are likely to cause sea levels to rise, change precipitation amounts and patterns, and increase the frequency of extreme weather events such as heat waves, droughts and floods.

The Intergovernmental Panel on Climate Change (IPCC) reports that moderate increases in mean temperatures (1–3°C), along with increased carbon dioxide and rainfall changes, could benefit crop yields in temperate regions but have detrimental effects for major cereals grown in low-latitude regions. Warming of more than 3°C would have detrimental effects for all regions (IPCC 2007b).

Carbon dioxide

Increasing atmospheric carbon dioxide may increase crop yields by stimulating photosynthesis and reducing water loss from plant respiration. Crops are generally divided into two groups, C3 and C4, depending on their photosynthetic pathway. C3 plants are generally less efficient at photosynthesis than C4 plants. C3 crops, such as rice, wheat, soybeans and legumes, are predicted to benefit more from increases in atmospheric carbon dioxide than C4 crops, such as maize, sorghum, millet and sugarcane (Zhai & Zhuang 2009).

Yields may increase by 10–15% for C3 crops and 0–10% for C4 crops when carbon dioxide levels reach 550 parts per million (ppm), noting that current carbon dioxide levels are about 400 ppm. However, considerable uncertainties surround estimates for carbon dioxide enrichment (IPCC 2007b).

Increases in atmospheric carbon dioxide may also stimulate chemical changes within plants, resulting in increased amounts of some toxins and decreased amounts of nutrients. For example, cassava plants grown under elevated atmospheric carbon dioxide contain more cyanogenic glycosides (plant toxins) and a lower protein content in their leaves than plants grown under current conditions (Gleadow et al. 2009).

Rainfall

Despite most projections showing a slightly greater chance of lower rainfall in the future, there is considerable uncertainty around how rainfall patterns will be affected by climate change. Higher concentrations of carbon dioxide and higher temperatures will mean that the hydrologic cycle (the movement of water from the air to land and back again) will increase in intensity, leading to higher evaporation and higher humidity. Yet, predicting where the rain will fall and in what quantities is difficult. In Australia, the south-west regions are most likely to experience the greatest decline in rainfall by 2070 (ABM 2010b).

Conversely, high rainfall may also be a problem as extreme events become more likely in some areas, leading to a greater occurrence of floods and soil erosion (CSIRO 2007).



Water availability

Inadequate soil moisture is a major cause of low crop productivity. The interaction of temperature increases and changing rainfall patterns will determine the impact of climate change on soil moisture. With rising temperatures, both evaporation and precipitation are expected to increase.

If global temperatures rise, the IPCC reports that water availability is likely to increase at high latitudes and decrease in mid-latitudes, with dry regions becoming drier and wet regions becoming wetter. Regions prone to drought are likely to experience more severe dry periods. Heavy rainfall events are likely to increase, as is the risk of flooding.

Ecological change

Global warming may also generate other ecological changes that could affect agricultural production. For example, patterns of pests and diseases may vary with climate change, leading to losses in productivity.

As a result of lower soil moisture, increased occurrence of drought, and likely reductions in annual rainfall in many areas, the negative effects of climate change are likely to outweigh any positive aspects (IPCC 2007b).

Marine environments and fisheries

The effects of climate change are also likely to extend to marine environments. Changes in marine environments and rainfall patterns mean that the fishing industry and other forms of aquaculture may be affected. For example:

- Increased acidification of the oceans (due to increasing levels of atmospheric carbon dioxide) may reduce productivity at the base of the food chain (such as phytoplankton) (Poloczanska & Richardson 2009).
- An increased frequency of extreme weather events and sea level rises may adversely affect aquaculture infrastructure, particularly along the coast (CSIRO 2008).
- Reduced rainfall may affect estuarine and mangrove aquaculture due to reduced freshwater inflows. While growth rates for some species may increase, migration patterns of other species may change (CSIRO 2008).

Effects of food production on climate change

The food and agriculture industry is a notable source of greenhouse gases, due to emissions from livestock, chemical inputs, soil disturbance, use of agro-machinery, food transportation and waste.

As well as carbon dioxide, two other significant greenhouse gases are generated during food production. Methane and nitrous oxide, although present in the atmosphere in smaller quantities than carbon dioxide, have a much greater global warming potential. Globally, methane and nitrous oxide make up about a quarter of greenhouse gas emissions caused by humans (IPCC 2007a).

Data on the effects of food production on climate change are limited. However, a few key points have been established:

- Livestock contribute to greenhouse gas emissions, with meat and dairy products also the most energy-intensive foods (Department of Climate Change and Energy Efficiency 2010).
- Meat and dairy, as well as rice, wheat and soy products, also use substantial amounts of water for production (Water Footprint Network 2011).





- The relationship between food transport distance and environmental impact is not a simple one as most processed foods use various ingredients transported from many different areas (Rama & Lawrence 2008).
- A high proportion of food is thrown away (wasted), resulting in the generation of unnecessary emissions in the production process (Lundqvist et al. 2008).

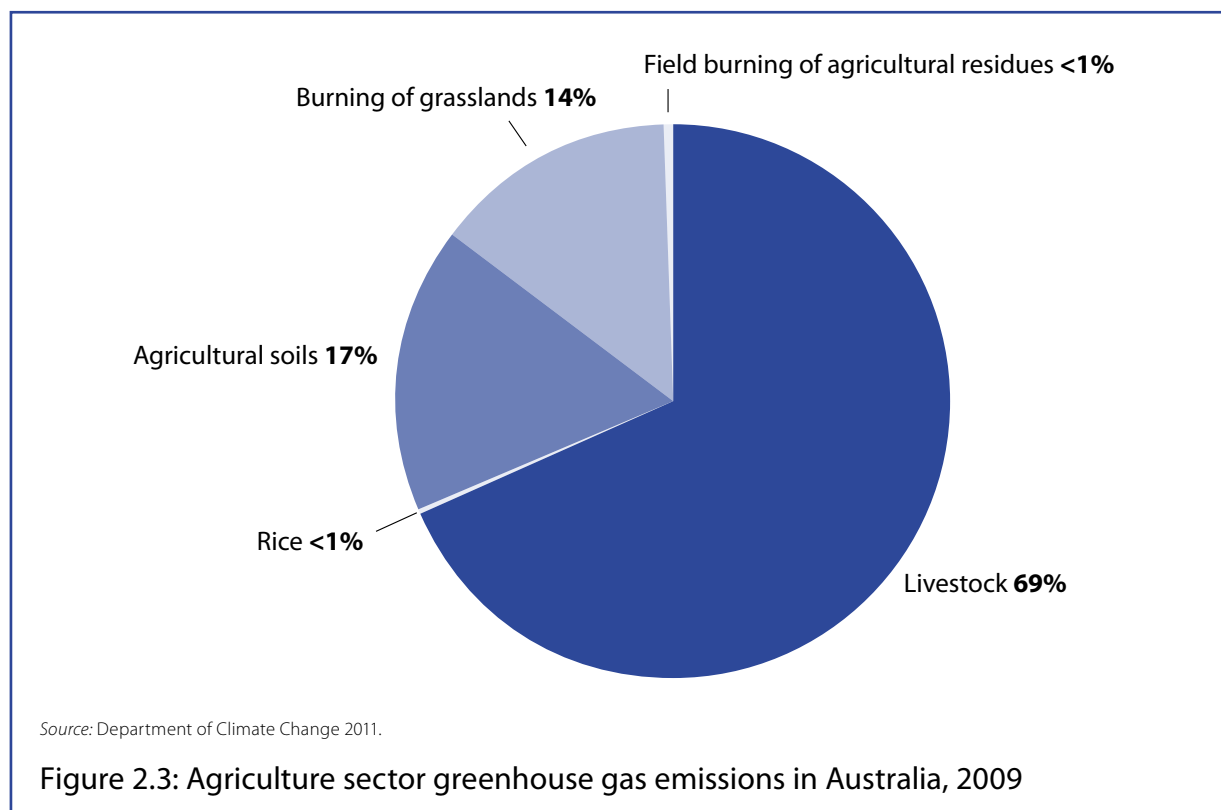
Agriculture

Agriculture contributes to greenhouse gas emissions in the following ways:

- carbon dioxide releases associated with land clearing, such as burning of grasslands for pasture management, fuel reduction and prevention of bushfires
- methane releases from enteric fermentation in livestock, due to microbial digestion of feed by some ruminant (mostly cattle and sheep) and non-ruminant livestock
- nitrous oxide releases from fertiliser application
- methane releases from rice cultivation, due to anaerobic decay of organic matter when rice fields are flooded.

Australian data show that the agriculture sector produced about 16% of national emissions in 2009, slightly higher than the global average (14%) (IPCC 2007a). This sector is the main national source of methane and nitrous oxide, accounting for 58% and 76% of the net emissions of these gasses respectively (Department of Climate Change 2011).

Due to enteric fermentation and manure management, livestock produced the majority (69%) of agricultural emissions. Cropping, pastures and soils contributed another 17% to agricultural emissions, mainly as nitrous oxide from the application of fertilisers and from nitrogen-fixing crops and pastures. Other emission sources included the field burning of agricultural residues (mainly stubble burning of wheat crops and sugar cane before harvest) and the prescribed burning of grasslands (Figure 2.3).





Greenhouse gas emissions from food production are strongly related to the type of food being produced. Australia's climate will be negatively affected by increasing demand for foods such as meat and dairy as production of these foods contributes substantially to greenhouse gas emissions. A particular concern is that many developing countries with large populations will go through the 'nutrition transition', where grain-based diets are abandoned in favour of animal-based products and processed foods.

Food transport

The concept of 'food miles' proposes that the greater the distance food is transported from the area of production, the greater the environmental impact. Consumers can theoretically reduce the environmental impact of their food consumption by buying seasonal, locally grown produce. Studies from the United Kingdom (Garnett 2003; UK Department for Environment Food and Rural Affairs 2005) suggest that although food transport is detrimental to the environment, there is a complex relationship between distance travelled and total emissions, with factors such as transport mode, logistics, and efficiency of production important considerations. Imported food transported by air was found to have a large environmental impact, while sea transport was relatively efficient.

Australia is a net exporter of food, with much of what we eat grown within the country. Although this equates to fewer international food miles, Australia is a vast country, so domestic food miles are high by international standards. One recent study (Gaballa & Abraham 2008) looked at estimated food miles for different products bought in Melbourne. The total distance of road transportation in one hypothetical food basket was about 21,000 kilometres (just under the total coastline length of Australia). Bananas, for example, can travel more than 2,500 kilometres by road to reach consumers in Melbourne. However, more research is needed to accurately assess the overall environmental impact of food transportation (Hogan & Thorpe 2009).

Refrigeration

Refrigeration is used to preserve, retain the aesthetic quality, and help reduce the seasonality of certain foods. However, refrigerators are also polluters due to their high energy demands and the refrigerant gases used (Garnett 2008). A study from the United Kingdom estimated that food refrigeration accounted for about 3% of all greenhouse gas emissions (and about 15% of all food life cycle emissions) (Garnett 2007).

Waste

Globally, it is estimated that nearly a half of all food produced is wasted or lost (Lundqvist et al. 2008). Although this leads to direct costs to the environment (through incineration and methane emissions from landfill), there are also substantial indirect costs through greenhouse gasses released earlier in the production process. Considerable energy losses occur when food is discarded due to the embedded resources required to produce, distribute and store food. More information on food waste in Australia is in Chapter 6.





2.5 Global nutrition in transition

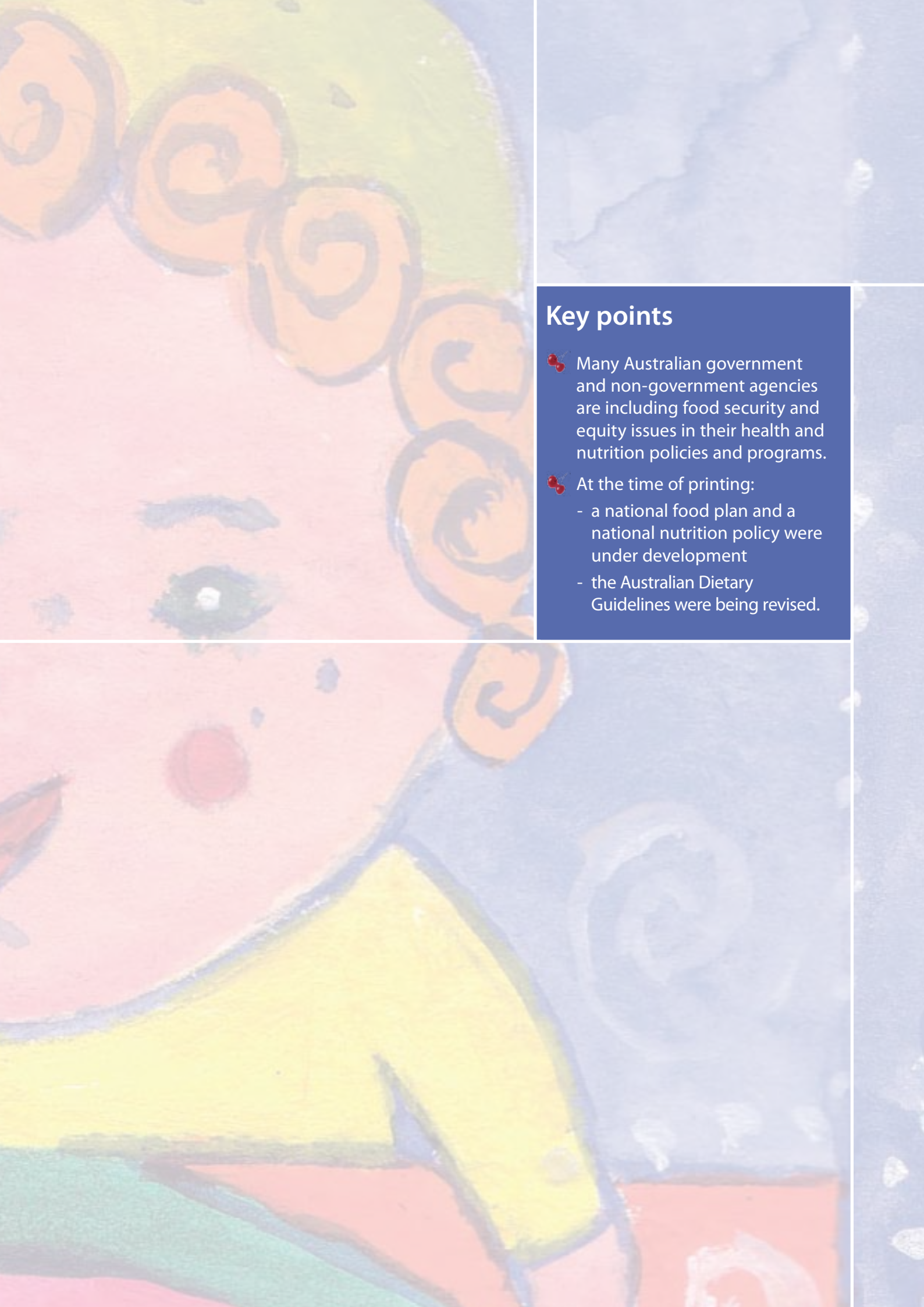


The human species has now moved from a time in history when the science of nutrition, and food and nutrition policy, have been principally concerned with personal and population health and with the exploitation, production and consumption of food and associated resources, to a new period. Now all relevant sciences, including that of nutrition, should and will be principally concerned with the cultivation, conservation and sustenance of human, living and physical resources together, and the health of the biosphere (The Giessen Declaration 2005).

Conventionally, nutrition science has had a biological emphasis, focusing on the nutrients needed for optimum health and disease prevention. In response to the emerging challenges facing the global food system, there has been increasing recognition that the scope of nutrition science needs to be broadened. A balance needs to be found between equitably promoting human health and supporting ecological sustainability (McMichael 2005).

In April 2005, a taskforce of the International Union of Nutritional Sciences (IUNS) met to review the nature and relevance of nutrition science and identify future directions. The outcome was The Giessen Declaration, which acknowledges that nutrition science should be integrated between biological, social and environmental approaches. It stresses the importance of considering the interconnected goals of personal, population and planetary health concurrently (The Giessen Declaration 2005).

The New Nutrition Science project was formulated to help address the nutritional challenges of the 21st century. The issues facing the food supply system are complex, extend across many sectors and require integrated solutions. Future food and nutrition policies will be strongly influenced by these new ways of thinking (Cannon & Leitzmann 2006).



Key points

- Many Australian government and non-government agencies are including food security and equity issues in their health and nutrition policies and programs.
- At the time of printing:
 - a national food plan and a national nutrition policy were under development
 - the Australian Dietary Guidelines were being revised.

The policy environment

3





3.1 Background

A wide range of government and non-government policies and programs (Box 3.1) influence the food supply, food distribution systems, food intakes and the health status of the Australian population. The policy process in Australia is influenced by the relationships between the Australian, state, territory, and local governments, and also by international obligations, such as trade agreements and treaties.

Box 3.1: Policies and programs

A 'policy' is typically described as a principle or rule to guide decisions and achieve rational outcome(s). They are generally formulated using the best available evidence, with consideration given to potential economic, social and political consequences. Government policies can be administered through actions such as legislation, regulations and administrative programs. A 'program' is a plan of action designed to achieve a policy outcome.

The role of government

Under Australia's federal system of government, power is shared between the Australian Government, the six state and two territory governments, and local governments.

Government health and nutrition policy activities

At the national level, the Australian Government Department of Health and Ageing develops and evaluates national policy, resources and initiatives in the areas of nutrition and healthy eating, and the promotion of physical activity and healthy weight. The National Health and Medical Research Council (NHMRC) coordinates the development of nutrition guidelines and recommendations such as nutrient reference values and the Australian Dietary Guidelines (NHMRC 2003a; NHMRC 2003b).

Each of the states and territories has a health department that is involved in nutrition-related activities. These departments often have nutrition policies or programs to guide their activities. Local government responsibilities include managing food safety in commercial food premises, waste disposal services, and creating supportive environments for healthy living.

Council of Australian Governments

The Council of Australian Governments (COAG) is a forum of Australian, state, territory and local government representatives whose role is to initiate, develop and monitor the implementation of policy reforms that are of national significance and require cooperative action by Australian governments. Examples include health, climate change and energy, water reform and natural disaster arrangements.

Under the COAG Reform Council, the health ministers of the Australian and state and territory governments collectively make up the Standing Council on Health, which has overall responsibility for Australia's health system, including the development, implementation and evaluation of national policies, programs and priorities, in relation to population health, chronic disease and child health and wellbeing. This council is supported by the Australian Health Ministers Advisory Council (AHMAC), a committee of the heads of the Australian Government and state and territory health authorities. AHMAC advises health ministers on policy, resources and financial issues.



The governance of food in Australia is the remit of a range of ministerial councils, including those responsible for primary industries, food regulation and health. Each of the ministerial councils/forums has a Senior Advisory Committee and specialist subcommittees. The food regulation system is overseen by the Legislative and Governance Forum on Food Regulation, which comprises ministerial representatives from all Australian governments and the New Zealand Government.

The health system

Australia's health system is a complex set of arrangements involving service provision, health providers, funding arrangements, participants and supporting mechanisms. Australians are a diverse group of individuals with different needs and expectations of the health system, shaped by such considerations as age, gender, locality and cultural background.

Health services include disease prevention and health promotion activities; clinical consultations (such as with a general practitioner (GP) or dentist); surgical procedures; medicines, pathology and imaging; and a range of other services. Services are offered by government and non-government providers in a variety of settings, and a large proportion are provided in hospitals. Funding comes from all levels of government, health insurers, non-government charitable organisations and individual Australians.

Health is an important and expensive business: in 2009–10, total health expenditure in Australia was \$121.4 billion, or 9.4% of gross domestic product (GDP) (AIHW 2011a). More than two-thirds was funded by government, with the Australian Government contributing two-thirds of this, and state, territory and local governments the other third. Individuals, private health insurers, and other non-government sources contribute the remaining health funding.

Since 2008, reform of the health system in Australia is changing the way services are funded and delivered. There has been a move towards improving performance reporting arrangements, government accountability and strengthening the evidence available to inform funding and policy decisions. COAG has committed \$872.1 million over 6 years (from 2009–10) to the National Partnership Agreement on Preventive Health and \$805.5 million over 4 years to the National Partnership Agreement on Closing the Gap in Indigenous Health Outcomes.

Further information on Australia's health system and health expenditure is available from *Australia's health 2012* (AIHW 2012a) or the Australian Institute of Health and Welfare (AIHW) website: <www.aihw.gov.au>.

The food regulatory system

Australia's food supply not only contributes to food and nutrition requirements, but is also a valuable commodity for generating trade and employment opportunities. While the food regulatory system is a balance between these objectives, the primary goal of food regulation is to ensure Australia has a safe food supply and informed consumers.





Overview

The food regulatory system consists of policy and laws relating to food. It includes the development of food policy and food standards, and implementation, enforcement, monitoring and surveillance activities (DoHA 2009). This cooperative arrangement includes the Australian Government, state, territory and local governments, and the New Zealand Government.

The system aims to:

- protect the health and safety of consumers by reducing food-related risks
- enable consumers to make informed food choices by providing sufficient information and preventing them from being misled
- support public health goals by promoting healthy choices, maintaining and improving the nutrition qualities of food and addressing specific public health issues
- enable a strong, sustainable food industry to help develop a diverse, affordable food supply and provide general economic benefit to Australia and New Zealand (DoHA 2009).

Protecting public health and safety is of paramount importance. A brief history of Australian food regulation is described in Box 3.2.

Box 3.2: History of food regulation in Australia

- Food regulation was initially established in Australia to protect consumers from unsafe food practices and dates from 1838 when the colony of New South Wales passed the Adulteration of Bread Act. While uniform food standards were promised in 1908, no successful mechanism for developing them was found for more than 80 years (Polya 2001).
- Australia's food regulatory body, the National Food Authority (NFA), was established on 19 August 1991 after the proclamation of the *National Food Authority Act 1991*. The NFA's role was to develop, vary and review standards for food available in Australia. State and territory governments agreed to adopt, without variation, standards developed by the authority and approved by the National Food Standards Council. These reforms sought, in part, to consolidate food standards development and ensure uniformity between, and retain the involvement of, the states and territories (National Food Authority 1993).
- In 1995 a bi-national agency was created between Australia and New Zealand and the NFA became the Australia New Zealand Food Authority.
- Widespread changes to the legislation were proclaimed in 2002 after the release of the Blair Review in 1998 that sought ways to reduce the regulatory burden of Australia's food regulation regime while maintaining public health and safety imperatives. In 2002, the authority became Food Standards Australia New Zealand (FSANZ) and the roles and responsibilities were broadened to include the development of primary production and processing standards.
- Further wide-ranging amendments were made to FSANZ's legislation in 2007, particularly affecting its standard-setting process, as a result of a review by food regulation ministers.

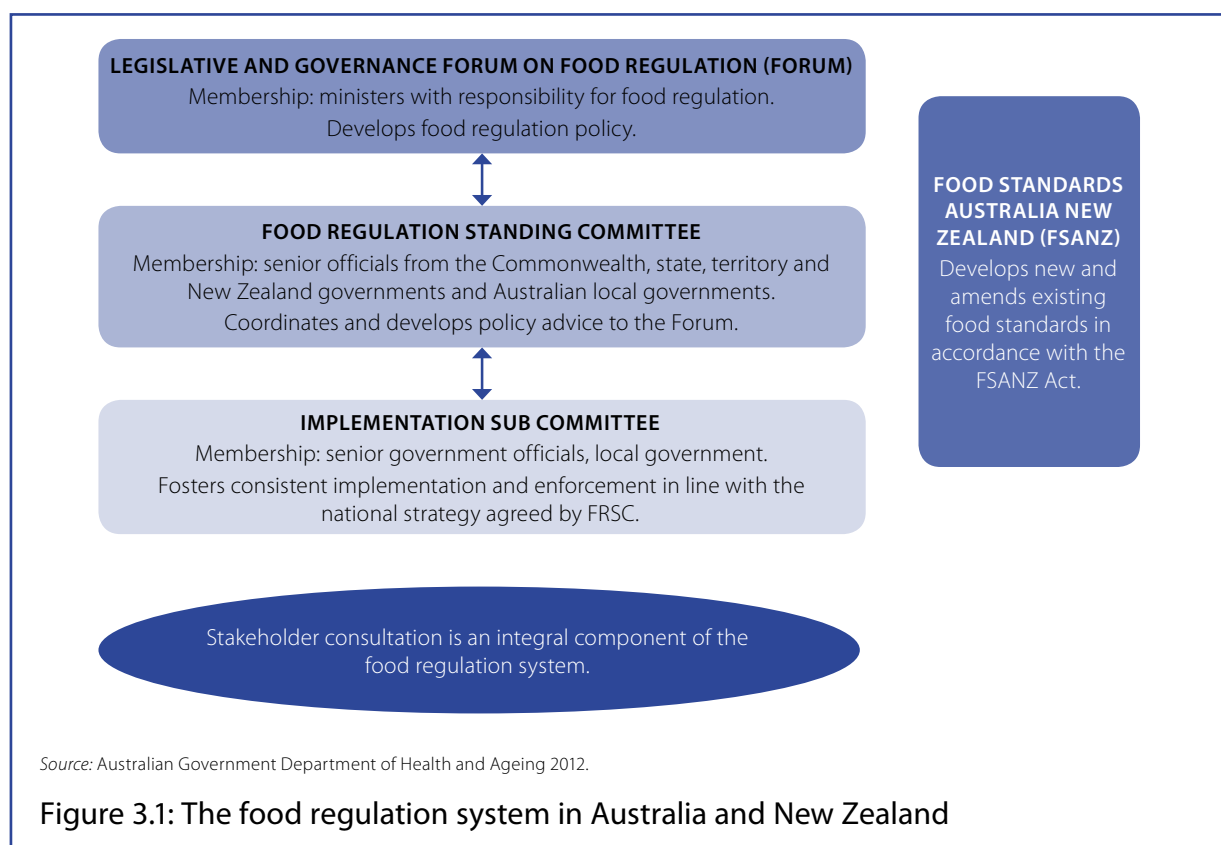




Policy and standards development

One of the most important features of the food regulatory system is the separation of policy decision-making from the development of food standards. The Legislative and Governance Forum on Food Regulation (the Forum—convening as the Australia and New Zealand Food Regulation Ministerial Council) is a ministerial-level committee that sets the policy framework for the development of food standards. FSANZ develops standards that have regard to this policy framework in consultation with other government agencies and with input from stakeholders to form a model food Act (Figure 3.1). The Forum can request FSANZ review its decisions and can then either accept, amend or reject the decision after a review by FSANZ. Each state and territory adopts the model food Act under state legislation and has responsibility to implement and enforce the food standards developed by FSANZ. Local government agencies are also involved in certain monitoring and enforcement activities.

FSANZ is an independent statutory authority responsible for developing all domestic food standards based on risk analysis using the best available scientific evidence. Collaboration with international food regulatory agencies, including the Codex Alimentarius Commission, enhances FSANZ's scientific expertise and helps to maintain the safety of the food supply. Further information on food regulation and the food standard-setting process is available on the FSANZ website: <www.foodstandards.gov.au>.



The Australia New Zealand Food Standards Code

The *Australia New Zealand Food Standards Code* (the Code) includes standards that regulate the use of ingredients, processing aids, colours, additives, vitamins and minerals in food produced in, or imported into, Australia and New Zealand. Standards also cover new technologies, such as novel foods, and Australia-only standards for primary production, such as dairy and meat, as well as food processing and food hygiene. FSANZ develops labelling standards for both packaged and unpackaged food, including specific mandatory warnings or advisory labels, for example, allergen labelling. More information on food labelling is in Chapter 5.





Review of Food Labelling Law and Policy

In January 2011, the independent Panel for the Review of Food Labelling Law and Policy presented its final report *Labelling logic* to the Australian, state and territory governments (Blewett et al. 2011). Outcomes of the review included a comprehensive framework to guide future labelling law and policy development and 61 specific recommendations. These included development of a national nutrition policy that encompasses establishment of an effective food and nutrition monitoring and surveillance system and a clear, consistent, transparent and informative food labelling system for consumers, industry and government.

Following the release of *Labelling logic*, the Forum developed a response and action plan which acknowledged that the food labelling regulatory framework must support a sustainable and profitable food industry while working to achieve positive public health outcomes (Legislative and Governance Forum on Food Regulation 2011). These reports are available from the Food Labelling Law and Policy website:

<<http://www.foodlabellingreview.gov.au/internet/foodlabelling/publishing.nsf/Content/home>>.

Labelling logic included recommendations on specific labelling requirements, for example, the development of an interpretative front-of-pack labelling system to help consumers to understand and interpret nutrition information on food labels and make healthy choices. While not a stand-alone strategy, it supports other public health strategies, such as the Australian Dietary Guidelines, and provides incentive for industry to improve the healthiness of the food supply.

Other Food Standards Australia New Zealand activities

FSANZ collaborates with other government agencies to monitor the food supply to ensure it is safe. The agency's role in food safety activities is covered in Chapter 4.

It also works closely with other agencies with links to food regulation, for example, the Australian Government Department of Agriculture, Fisheries and Forestry (DAFF), which has responsibility for developing a national food plan. The Office of the Gene Technology Regulator controls genetically modified (GM) organisms while FSANZ approves any GM commodities or animals for use in food. GM food is discussed further in Chapter 4. The Australian Pesticides and Veterinary Medicines Authority sets limits and procedures for the use of agricultural and veterinary chemicals for crops and animals in the food supply. It also has the power to set safe levels for chemical residues in food.

Responsibility for imported food is shared jointly between FSANZ and DAFF Biosecurity (formerly the Australian Quarantine and Inspection Service—AQIS). FSANZ undertakes food risk assessments and DAFF Biosecurity has responsibility for inspection and sampling. Imported food must comply with the *Imported Food Control Act 1992*, as well as the Code. More information on food regulation is available from the Food Regulation Secretariat website (DoHA 2009) and the FSANZ website (FSANZ 2012a).

3.2 Policies influencing the food supply

Global and local factors such as socioeconomic conditions, population growth, climate change, agricultural land and water availability, and consumer demand for a safe, sustainable food supply all exert influence on food production, consumption, and nutrition and health outcomes for Australians.

The Australian Government develops food- and nutrition-related policies in the broader social, economic and environmental policy areas. Many Australian government agencies are directly or indirectly involved in policies and programs across the food chain, including food production and distribution to consumption (DAFF 2011). These policies and programs influence some or all stages of the food chain and often interrelate (Table 3.1).





Previously, there has been no overarching approach to food policy in Australia; however, development of a new national food plan is underway (Australian Government 2010; Legislative and Governance Forum on Food Regulation 2011).

Table 3.1: National policies and programs influencing food production, availability and consumption

Activity	Key Australian Government policy/regulation
Land use and environment	- Environment protection and research - Sustainable use of natural resources - Biodiversity - Sustainable agricultural, fisheries and forestry practices - Land contamination - Water policy and resources - Renewable energy programs - Community and household climate action
Primary production	- Use of chemicals, fertilisers, and pesticides - Carbon emission reduction - Subsidies, levies - Gene technology
Biosecurity	- Quarantine and biosecurity - Export certificates
Transport	- National transport regulatory frameworks - International maritime codes and conventions - Fuel tax
Food manufacture and packaging	- Food and packaging standards and policies (national and international) - Food safety - Food labelling - Food medicine interface - National food plan - Food and health dialogue
Health and nutrition ^(a)	- National nutrition policy - Nutrition guidelines - National preventive health policies - Indigenous health policies
General	- Industrial relations - Immigration - Competition laws - Marketing and advertising - World Trade Organization obligations - Market access and trade agreements - Industry subsidies and levies - Taxation

(a) A more comprehensive list of national policies and programs that influence health and nutrition is in Table 3.2.

Source: Adapted from DAFF 2011.





National food plan

In 2011, the Australian Government initiated the development of a national food plan to integrate food policy by looking at the whole food supply chain, to protect Australia's food security, and to develop a strategy to maximise food production opportunities. They released an issues paper (DAFF 2011) to stimulate community discussion about issues affecting food and what a national food plan should aim to achieve. The paper envisaged a national food plan that would seek to 'better integrate Australia's approach to food policy, from production through to consumption, and be consistent with the government's market-based policy approach and commitment to fiscal discipline'.

As well as economic issues, a national food plan requires a coordinated and integrated policy that addresses human health, social equity issues and the environment to ensure all sections of the food chain are included. In addition, a comprehensive implementation plan, infrastructure support and ongoing monitoring would avoid duplication or conflicting approaches. As such, an integrated national food plan would encompass proposed key nutrition-related policies such as a national nutrition policy, the Australian Dietary Guidelines and a national food and nutrition monitoring and surveillance system. More information regarding the development of a national food plan is available from the DAFF website: <www.daff.gov.au/agriculture-food/food/national-food-plan>.

Goods and services tax

On 1 July 2000, the goods and services tax (GST), a broad-based consumption tax, was introduced. This tax is set at 10% of the price of most goods and services and is paid by the final consumer, but it is not applicable to 'basic' food items (Box 3.3). This exemption was crucial to the successful passage of the legislation through Parliament due to concern that taxing food would result in inequity within the population. Kenny (2000) showed that low income earners spend a greater proportion of their food expenditure on basic food items.

There is some evidence that, contrary to expectations, the price of healthy food items which did not attract the GST increased more than other food items, such as soft drinks, especially in remote areas (Harrison et al. 2007). However, other factors, including retailing issues and transport costs may have contributed to these cost increases.

Box 3.3: Selected taxable and non-taxable food items under the GST

Schedules 1 and 2 of *A New Tax System (Goods and Services Tax) Act 1999* includes an extensive definition of taxable and GST-free food to assist with clarity (Office of Legislative Drafting and Publishing 1999). The GST also applies to food for consumption on the premises from which it is supplied, and hot food for consumption away from those premises.

Non-taxable

Plain bread/rolls, breakfast cereals
Cooking ingredients (flour, sugar, oils)
Fruit, vegetables (fresh, frozen, canned)
Unflavoured milk, cheese, eggs
Meats, fish, chicken
Bottled water, juice (> 90% fruit)
Baby food and infant formula

Taxable

Cakes, biscuits, pastries, pies, sausage rolls
Savoury snacks, confectionary, ice-cream
Prepared food and meals
Flavoured milk, milkshakes
Hot food (takeaway), e.g. cooked BBQ chicken
Soft drinks, flavoured waters, sports drinks
Food and drinks sold in restaurants



3.3 National policies and programs influencing health and nutrition

Much of the burden of disease in Australia is due to excessive consumption of energy-dense and relatively nutrient-poor foods and/or insufficient consumption of vegetables, fruits and wholegrain cereals (National Preventative Health Taskforce 2009a). Food consumption data and health status are discussed in chapters 7 and 8.

Obesity is a common risk factor underlying the development of chronic diseases such as cardiovascular disease, Type 2 diabetes and some cancers. Policies that prevent or reduce obesity have the potential to improve the health and wellbeing of Australians and decrease health-care costs. Many current national health-related policies focus on obesity prevention and reduction. Table 3.2 includes key national policies and programs that have influenced health and nutrition activities over the last 20 years.

Table 3.2: Key national government policies, programs and policy tools influencing health and nutrition, 1992–2012

Date	Policy/program	Key features
1992	Dietary Guidelines for Australians	Advice on healthy food choices to contribute to a healthy lifestyle and reduce the risk of diet-related diseases.
	Australia's Food and Nutrition Policy	Improve knowledge and skills; food and nutrition objectives in policy; people with special needs, monitoring and surveillance.
1994	The Core Food Groups: the Scientific Basis for Developing Nutrition Education Tools	A consistent basis for the development of a range of nutrition education tools.
1996	National Public Health Partnership—Strategic and Integrated Response to Public Health Priorities	Priority areas—healthy weight, child public health, information development and workforce development and planning.
	National health priority areas	Cardiovascular health, cancer, injury prevention, mental health, diabetes mellitus (1997), obesity (1998).
1997	Australia's Weight: a Strategic Plan for the Prevention of Overweight and Obesity.	Aim—to prevent further weight gain and reduce adult overweight and obesity; and ensure healthy growth of children.
1998	<i>The Australian guide to healthy eating</i>	Practical resource to help Australians develop the skills and knowledge needed to choose a healthy diet.
1999	Dietary Guidelines for Older Australians	Practical advice about nutritious eating for older Australians to promote and maintain a healthy lifestyle.
2001	Eat Well Australia: an Agenda for Action for Public Health Nutrition (2000–2010)	'Whole of population' priorities for vulnerable groups, fruit and vegetable intakes, women, infants and children, obesity prevention.
	National Aboriginal and Torres Strait Islander Nutrition Strategy and Action Plan	Food supply, food security, economic status, nutrition and social issues, Indigenous nutrition workforce and information systems.
2003	Dietary Guidelines for Adults, Children and Adolescents (incorporating the Infant Feeding Guidelines for Health Workers)	Food and diet recommendations to promote health and reduce diet-related conditions and chronic disease risk. Focus on food groups and lifestyle patterns, rather than specific nutrients.

continued





Table 3.2 (continued): Key national government policies, programs and policy tools influencing health and nutrition, 1992–2012

Date	Policy/program	Key features
2005	National Chronic Disease Strategy (NHPAC 2005)	Priority areas included asthma, cancer, diabetes, heart, stroke and vascular disease, and arthritis and osteoporosis.
2006	Nutrient Reference Values for Australia and New Zealand, incorporating Recommended Dietary Intakes (NHMRC & NZMoH 2006)	Recommendations for an adequate nutritional intake for healthy people and to prevent chronic diseases.
2008	National Partnership Agreement on Preventive Health over 6 years from 2009–10 (COAG 2008b)	States and territory programs for children and workplaces targeting fruit and vegetable intake, obesity, alcohol, smoking.
	National Partnership Agreement on Closing the Gap in Indigenous Health Outcomes	Priorities—life expectancy, childhood mortality, education and unemployment (COAG 2008a).
2009	Parliamentary committee inquiry report Weighing it Up: Obesity in Australia (Australian Parliament 2009)	Obesity prevalence, and recommendations for prevention and management.
	National Preventative Health Strategy (National Preventative Health Taskforce 2009b)	Priority areas addressed include—obesity, tobacco and alcohol misuse.
	National Strategy for Food Security in Remote Indigenous Communities (COAG 2009)	Resources to improve access to healthy food in remote areas through national, state and territory collaboration.
	The Food and Health Dialogue (for manufactured foods)	Aims to reduce saturated fat, added sugar, sodium and energy, and increase fibre, wholegrain, fruit and vegetable content.
	Australian National Breastfeeding Strategy 2010–2015 (Australian Health Ministers' Conference 2009)	Aims to improve the health, nutrition and wellbeing of infants and young children, and mothers, by promoting breastfeeding.
2010–12	Draft Australian Dietary Guidelines, incorporating the Australian Guide to Healthy Eating (NHMRC 2011)	Evidence-based recommendations that focus on food choice rather than nutrients.
2011	National Nutrition Policy development agreed and referred to Australian health ministers	Framework to identify, prioritise, drive and monitor nutrition initiatives including the role of food labelling in public health.

Source: Adapted from DoHA 2012.

Since the development of a set of National Health Priority Areas in 1996 in response to the WHO's global strategy for health for all by the year 2000, the Australian Government has focused public attention and health policy on areas considered to contribute significantly to the burden of disease in Australia, and for which there is potential for health gain. For example, food and nutrition issues have played an integral role in many national policies and strategies to reduce the prevalence and burden of chronic disease and associated risk factors, to help reduce associated health costs (Table 3.2).

Since 2007, the Australian Government has focused on preventive health in an attempt to improve the health of Australians and reduce pressure on the health system. National health policies currently include a focus on the prevention of chronic diseases and a reduction in the proportion of people who are overweight or obese.





National Partnership Agreement on Preventive Health

Under the National Partnership Agreement on Preventive Health, the Australian Government is providing \$872.1 million for preventive health initiatives over 6 years from 2009–10. This is the largest investment made by an Australian Government in preventive health.

The partnership commits governments to address the rising prevalence of lifestyle-related chronic diseases by implementing programs and activities that promote healthy behaviours in the daily lives of Australians, with support from social marketing messages and health reporting infrastructure—including the Australian National Preventive Health Agency.

Activities include:

- **Healthy Workers**, which provides funding to states and territories to implement healthy living programs through workplaces. These programs focus on decreasing rates of overweight and obesity, increasing levels of physical activity and intake of fruit and vegetables, smoking cessation and reducing harmful levels of alcohol consumption.
- **Healthy Children**, which provides funding for the states and territories to implement programs that promote greater levels of physical activity and better nutrition in settings such as child care centres, preschools, schools, multidisciplinary service sites and family centres. Programs are targeted to children aged from birth to 16.
- **Healthy Communities**, which involves targeted progressive roll-out of community-based healthy lifestyle programs through local government authorities that facilitate increased access to physical activity, healthy eating and healthy weight programs and activities for disadvantaged adults predominantly not in the paid workforce.
- **Industry Partnership** between relevant food, weight management and fitness industries and non-government sectors to work cooperatively in redirecting consumer demand and industry supply toward healthy lifestyle choices.
- **Social Marketing** through the 'Measure Up' and 'Swap It Don't Stop It' campaigns, to promote healthy lifestyles and educate consumers on the effect of dietary and lifestyle choices on their health (see Chapter 5).
- **Enabling Infrastructure** activities include:
 - Establishing the Australian National Preventive Health Agency to provide policy advice to ministers, build evidence through analysis and research, and manage social marketing activities.
 - Expanding the National Nutrition and Physical Activity Survey to include individuals of all ages, Aboriginal and Torres Strait Islander Australians, and biomedical measures, which are all part of the Australian Health Survey.
 - A Workforce Audit to support the National Partnership, leading to a long-term strategy for improving the preventive health workforce in Australia.
 - The Preventive Health Research Fund, to be administered by the Australian National Preventive Health Agency, which will support policy development through translational research.
 - Expanding the National Eating Disorders Collaboration to increase its capacity to develop a consistent and comprehensive approach to prevention, early intervention and management of eating disorders.
 - Expanding state and territory surveillance capacity for lifestyle risk factors, with emphasis on supporting existing infrastructure and monitoring of performance benchmarks.





National nutrition policy

In 2012–13, the Australian Government will begin developing a national nutrition policy to provide a long-term overarching framework to guide programs and policies aimed at reducing the burden of nutrition-related disease and educating and encouraging consumers to choose a healthy diet (Legislative and Governance Forum on Food Regulation 2011).

The policy will identify, prioritise, drive and monitor nutrition initiatives, while taking into account current public health nutrition initiatives and the needs of vulnerable groups. Consideration will also be given to including a framework for the role of food labelling in influencing public health.

In developing the policy, the expertise of food regulators and public health organisations will be engaged to ensure objectives are practical and achievable within the food regulatory system and meet the needs of the Australian population now and in the future.

Key stakeholder groups are calling for all sectors related to food to collaborate to develop an integrated food and nutrition policy that would address chronic disease, environmental sustainability, social equity and the economy. This would help to maintain and promote the health, wellbeing and prosperity of Australians for future generations (PHAA 2012).

Box 3.4 outlines the previous 1992 National Food and Nutrition Policy, and the establishment of the Strategic Intergovernmental Nutrition Alliance (SIGNAL) to oversee the development of a Public Health Nutrition Strategy.

Box 3.4: National Food and Nutrition Policy (1992)

Australia's first National Food and Nutrition Policy commenced in September 1992 with the following four priority objectives:

- improvements in the knowledge and skills necessary for Australians to choose a healthy diet
- incorporation of food and nutrition objectives into a broad range of policy areas and sectors
- support for community based initiatives to improve the diet of people with special needs
- ongoing monitoring and surveillance of the food system.

The policy was developed to facilitate and support action through the entire food and nutrition system—food production, processing and distribution, and nutrition knowledge and education—in order to achieve better nutrition for all Australians, especially those most disadvantaged. Its fundamental aim was to assist in making healthy choices easy choices for all Australians.

Phase 1 of the policy was implemented between 1992 and 1996. In 1998, SIGNAL was established to oversee the development of a Public Health Nutrition Strategy as the framework for Phase 2 implementation of the policy (Commonwealth Department of Health and Family Services 1998).

Eat Well Australia: An agenda for Action in Public Health Nutrition, 2000–2010 (Eat Well Australia), which included the National Aboriginal and Torres Strait Islander Nutrition Strategy and Action Plan, provided a whole of population approach to build on and support state and territory nutrition strategies (SIGNAL 2001).



**Box 3.4 (continued): National Food and Nutrition Policy (1992)**

The goal of Eat Well Australia was to improve the health of all Australians through improving nutrition and reducing the burden of diet-related disease (SIGNAL 2001). There were three major domains to the strategic framework—health gain, capacity building and strategic management—and various initiatives as part of the agenda for action. The health gain components were simplified into four priority areas:

- improving nutrition for vulnerable groups
- increasing the consumption of vegetables and fruit
- promoting optimal nutrition for women, infants and children
- preventing overweight and obesity.

SIGNAL played a major role in coordinating the implementation of Eat Well Australia, prior to being disbanded in 2006. In response to Eat Well Australia, state and territory governments developed public health nutrition policies and/or plans that reflected their main population concerns and policy directions. Further information on SIGNAL and Eat Well Australia is available from the National Public Health Partnership website: <www.nphp.gov.au/index.htm>.

Community and non-government food and nutrition policies

Many national and state-based food and nutrition policies and programs are being adopted and implemented in a range of settings. For example, policies on the types of foods that can be served to children and adolescents are being introduced into child care centres and schools. Local governments are introducing policies for food outlets in their municipalities to encourage the provision of healthy food choices. Various non-government organisations are involved with the development of food and nutrition policies, such as the Public Health Association of Australia, Dietitians Association of Australia, Nutrition Australia, the National Heart Foundation and the Australian Food and Grocery Council.

Indigenous health

The available evidence suggests that Indigenous Australians continue to suffer a greater burden of ill health than the rest of the population (AIHW 2011b). Nutrition, alcohol consumption, smoking and use of other drugs and substances are some of the key health risk factors that contribute to the greater burden of ill health experienced by Indigenous Australians compared with their non-Indigenous counterparts. Many Indigenous Australians live in remote areas and do not have the same opportunities as other groups to obtain affordable, healthy food.

National Aboriginal Torres Strait Islander Nutrition Strategy and Action Plan

The National Aboriginal Torres Strait Islander Nutrition Strategy and Action Plan provided a nationally agreed framework to improve Aboriginal and Torres Strait Islander health through better nutrition. It was developed as a component of Eat Well Australia and endorsed by all Australian health ministers in August 2001.

The seven priority areas were: food supply in rural and remote communities, food security and socioeconomic status, family-focused nutrition promotion, nutrition issues in urban areas, the environment and household infrastructure, the Aboriginal and Torres Strait Islander nutrition workforce, and national food and nutrition information systems.





These action areas aimed to improve the nutritional health of Indigenous Australians through tackling factors that influence food choices and nutrition in Indigenous communities, for example, social, economic, geographical, environmental and infrastructure issues.

Key achievements included:

- Development and implementation of the Remote Indigenous Stores and Takeaways project that aimed to improve access to good quality, affordable, healthy foods in remote communities. Guidelines and resources were developed to assist managers of stores and takeaway food outlets, as well as health and nutrition stakeholders, to improve the availability and reduce the cost of healthy food choices.
- Inclusion of nutrition as a core component of the national Aboriginal and Torres Strait Islander Health Worker training package.
- Increased Indigenous nutrition content, and the development of specialist Indigenous nutrition courses at five universities.
- Extension of the nutrition component of Australian Indigenous HealthInfoNet.
- Organising a national Nutrition Networks Conference for Aboriginal and Torres Strait Islander nutrition and health promotion workers in Alice Springs in 2008.
- Advocacy for improving Aboriginal and Torres Strait Islander nutritional status.

In 2009–10, the Australian Government completed an evaluation of the strategy and action plan, which examined how effectively it was implemented and identified ways it could be more effective and responsive in the current environment. Outcomes of this evaluation will be considered in the development of the National Nutrition Policy.

Closing the gap

In 2008, the Australian Government agreed to a National Partnership Agreement on Closing the Gap in Indigenous Health Outcomes to tackle important factors contributing to Indigenous disadvantage (COAG 2008a). Six priority targets to reduce the gap between Indigenous and non-Indigenous Australians address life expectancy, mortality rates in children under 5, access to early childhood education, literacy, Year 12 attainment and employment.

Under this agreement, the Australian Government has developed an Indigenous chronic disease package that aims to improve how the Australian health-care system manages the chronic diseases affecting many Indigenous Australians. Funding will assist management and follow-up care, and support the primary care workforce. It will also support campaigns and other community education programs targeting Indigenous Australians to reduce the prevalence of chronic disease risk factors, such as smoking, poor nutrition and lack of exercise.

Increasing the availability and affordability of high quality fresh food in remote Indigenous communities is critical to reduce illness and close the gap between Indigenous and non-Indigenous Australians. In December 2009, the Australian Government agreed to a National Strategy for Food Security in Remote Indigenous Communities (COAG 2009). A number of states and territories collaborated with the Australian Government to develop guidelines and resources to improve access to affordable, quality, healthy fresh foods in remote Indigenous communities. Each state and territory participating in the project has developed an individual plan for integration and dissemination of the resources within existing networks.





Australian Dietary Guidelines

Dietary guidelines are a key statement to support Australia's policy goals and directions for supporting better nutritional outcomes for the population. Guidelines are based on the best available evidence and a systematic review of the literature, and assist health professionals, policy makers, educators, food manufacturers, food retailers and researchers in promoting the benefits of healthy eating.

There have been a number of reviews of the dietary guidelines in Australia over the last 20 years. In this text the term Australian Dietary Guidelines refers to the *Dietary guidelines for Australian adults* (NHMRC 2003a) and the *Dietary guidelines for children and adolescents incorporating the infant feeding guidelines for health workers* (NHMRC 2003b).

In 2011, the NHMRC released the draft *Australian dietary guidelines, incorporating the Australian guide to healthy eating* for public consultation (NHMRC 2011). These build on previous guidelines and also incorporate the latest research from a range of evidence sources (Figure 3.2). The report *A modelling system to inform the revision of the Australian guide to healthy eating* details the serve sizes and minimum number of serves required to meet nutritional needs. The final version of the revised Australian Dietary Guidelines is expected to be available from the NHMRC website: <www.nhmrc.gov.au> in late 2012.

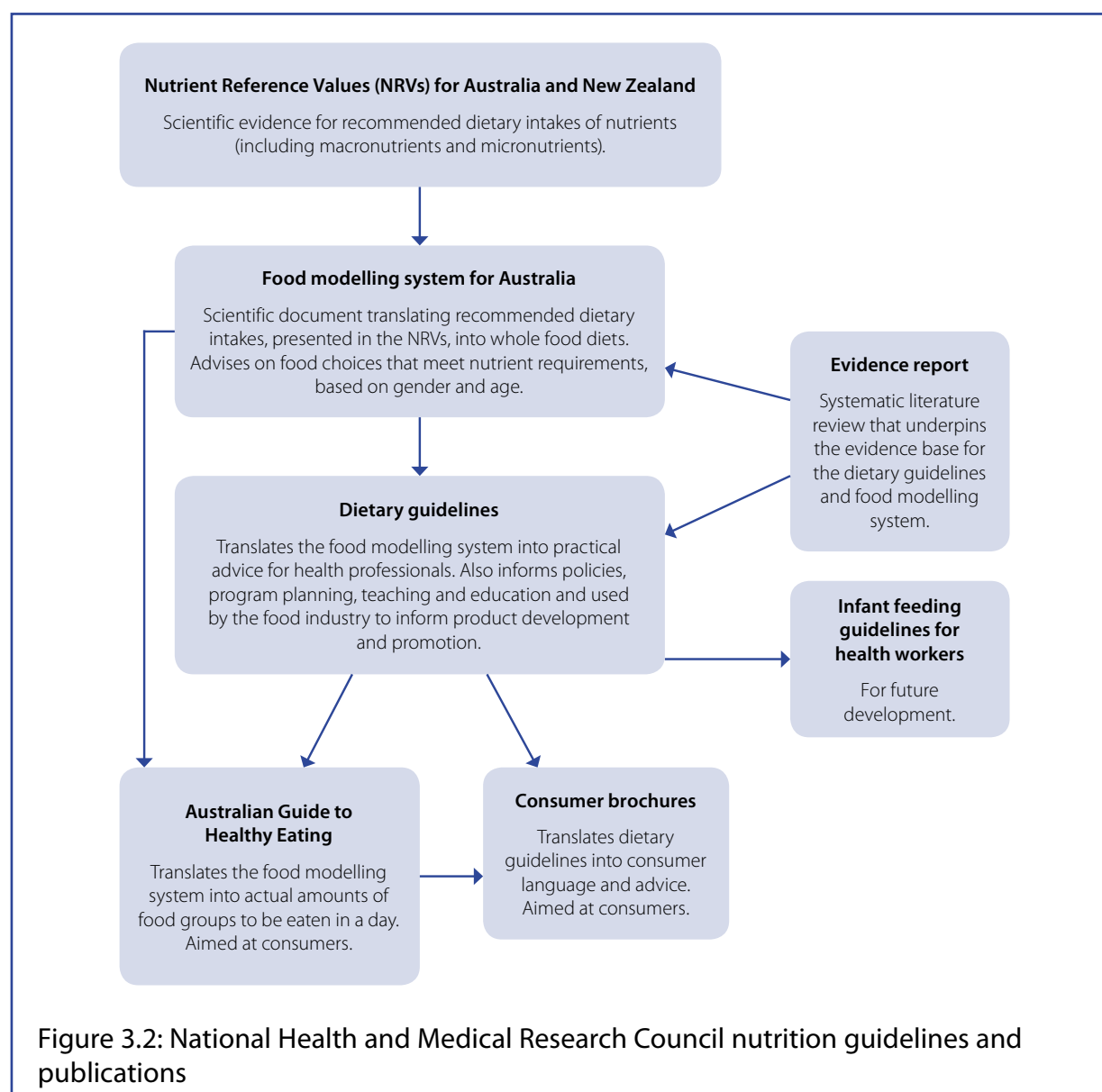


Figure 3.2: National Health and Medical Research Council nutrition guidelines and publications





Australian guide to healthy eating

While the Australian Dietary Guidelines provide general dietary recommendations, the *Australian guide to healthy eating* provides practical recommendations on the types and amounts of foods different population groups should eat every day (NHMRC 2011). It will be a useful tool for educating and evaluating Australian eating patterns. Along with the draft Guidelines and the *Infant feeding guidelines for health workers*, this document is being revised and the final version will be available from the NHMRC website: <www.nhmrc.gov.au> in late 2012.

3.4 Food and nutrition education

School education

While there is no consistent approach to food and nutrition education in schools across jurisdictions, this will change with the introduction of a national curriculum from Kindergarten to Year 12, which will include a focus on health and physical education in the next development phase (Australian Curriculum Assessment and Reporting Authority 2012). See Chapter 5 for more information.

Tertiary education

Formal education of health and food industry professionals depends on the availability and quality of tertiary education. Undergraduate food and nutrition programs include nutrition and dietetics, health sciences, public health nutrition, food science and nutrition, and consumer science. Nutrition is also an important component of medical and nursing training.

Dietetic and nutrition training

In Australia, the profession of dietetics contributes to the promotion of health, and the prevention and management of illness, by optimising the nutrition of communities and individuals. Dietitians use scientific principles and methods in the study of nutrition and apply these to influence the wider environment affecting foods consumed and eating behaviours.

The Dietitians Association of Australia (DAA) is the peak body representing over 4,800 dietetic and nutrition professionals. DAA contributes to the development of nutrition policies and programs and member dietitians provide advice to individuals and the community on government policies and programs such as the Australian Dietary Guidelines and the *Australian guide to healthy eating*.

Dietitians employed in the health system in Australian states and territories are not required to be registered under a Government scheme as is the case for GPs and nurses. Instead, the dietetic profession is self-regulated by DAA through its Accredited Practising Dietitian (APD) program, which provides a framework for continuing professional development activities to ensure compliance with DAA's processes. Dietitians with Australian-recognised qualifications are eligible to become APDs.

DAA provides accreditation of the tertiary level training courses to become a dietitian. Currently there are courses in the Australian Capital Territory, New South Wales, Queensland, South Australia, Victoria and Western Australia (DAA 2012). DAA also manages the recognition of dietitians trained in other countries who wish to work in Australia.





While a range of nutrition courses is available in Australia, only individuals who have high level tertiary qualifications in evidence-based human nutrition science are eligible to apply for Associate Membership of DAA. Graduates of Australian universities with qualifications in human nutrition science and at least five years of work experience in human nutrition are eligible to apply for the credential of Accredited Nutritionist. Further information is available from the DAA website: <http://daa.asn.au/universities-recognition>.

Members of the Nutrition Society of Australia (NSA) are qualified, practising scientists and educators from diverse disciplines with a common interest in the research and application of nutrition (Nutrition Society of Australia 2012). The NSA has established a Voluntary Register of Nutritionists to recognise and encourage high standards of professional training in nutrition. There are about 150 NSA members on the register which has 2 levels of recognition. Associate Nutritionists have a bachelor's degree majoring in nutrition or equivalent, while Registered Nutritionists have an additional 3 years of subsequent nutrition-related experience and/or formal study. Further information is available from the NSA website: <http://nsa.asn.au>.

Food science and food technology training

A wide range of courses in food science and technology are available at various educational levels, including post-graduate, undergraduate, diploma, certificate, short courses and in-house training. Topics include food safety systems and auditing, quality assurance processes, microbiology, food processing and engineering, allergen training, product innovation and marketing. The Australian Institute of Food Science and Technology is the national association representing individuals and companies from all sectors of the Australian food and associated agrifood industries.



Key points

- The food industry is an integral part of Australia's economy, with retail sales worth \$130.4 billion, followed by food and beverage processing (\$82.0 billion) and farm and fish food production (\$40.7 billion) in 2010–11.
- Australia has one of the most concentrated retail food sectors in the developed world, and the two major supermarket chains have almost 80% of the packaged grocery market.
- The food processing industry is the largest manufacturing industry in Australia.
- The beef industry is Australia's largest agricultural commercial activity, followed by the broadacre (cropping) industry, and the dairy industry.

Food production

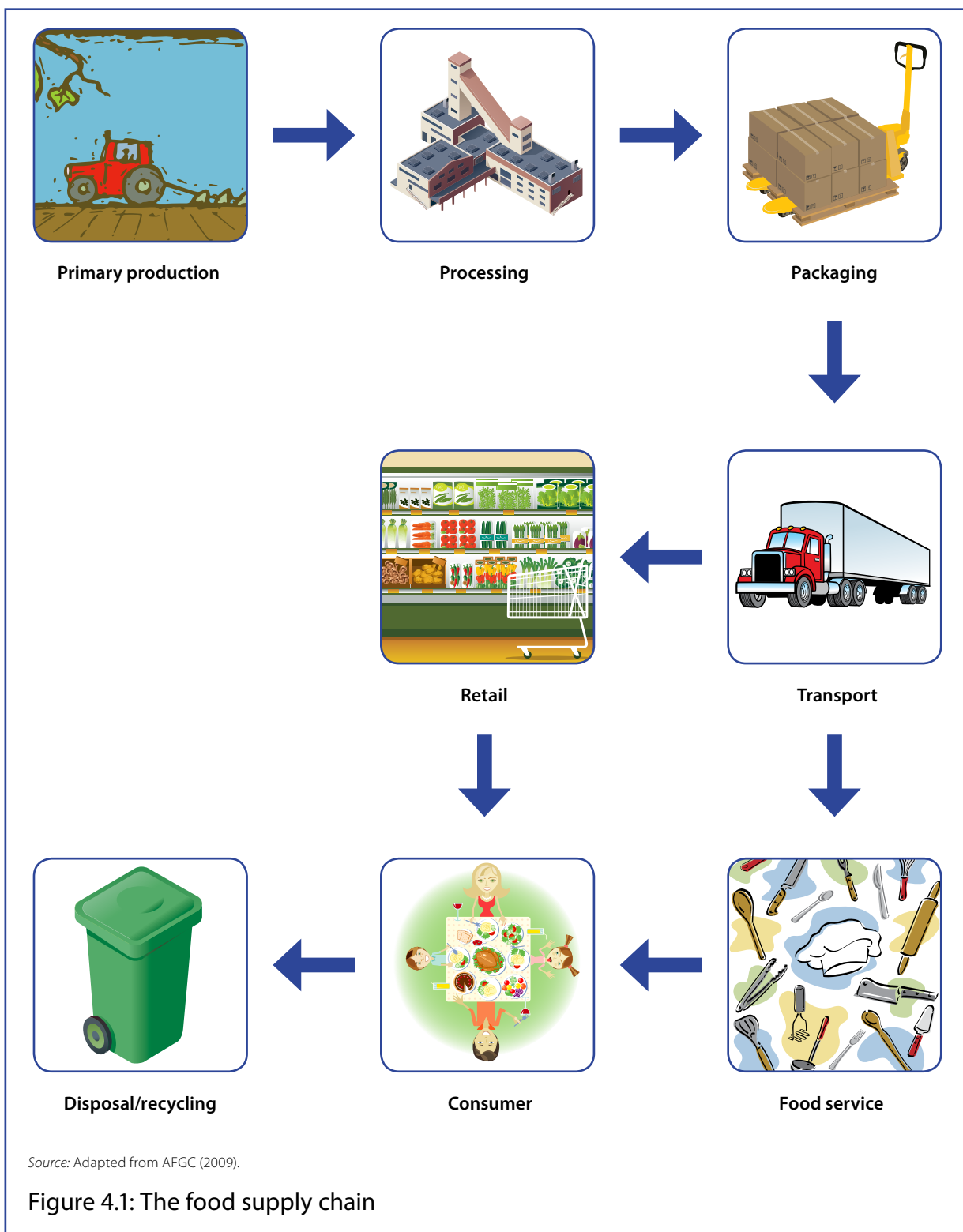
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The scope and nature of Australia's food supply is being shaped by global and local forces such as global population growth, differing economic growth rates among countries, climate change, finite natural resources and the increasing burden of obesity and chronic disease due to poor nutrition (DAFF 2011:1).

Australia's food system is complex and has many intersecting components. A simplified overview is shown in Figure 4.1.





4.1 Food industry components

The food industry can be divided into three components: primary (agriculture and fishing), secondary (manufacturing and processing) and tertiary (retail). These are defined in the Australian and New Zealand Industrial Classification System (ANZICS) jointly developed by the ABS and Statistics New Zealand to improve the comparability of industry statistics between the two countries and the rest of the world (ABS & Statistics NZ 2006).

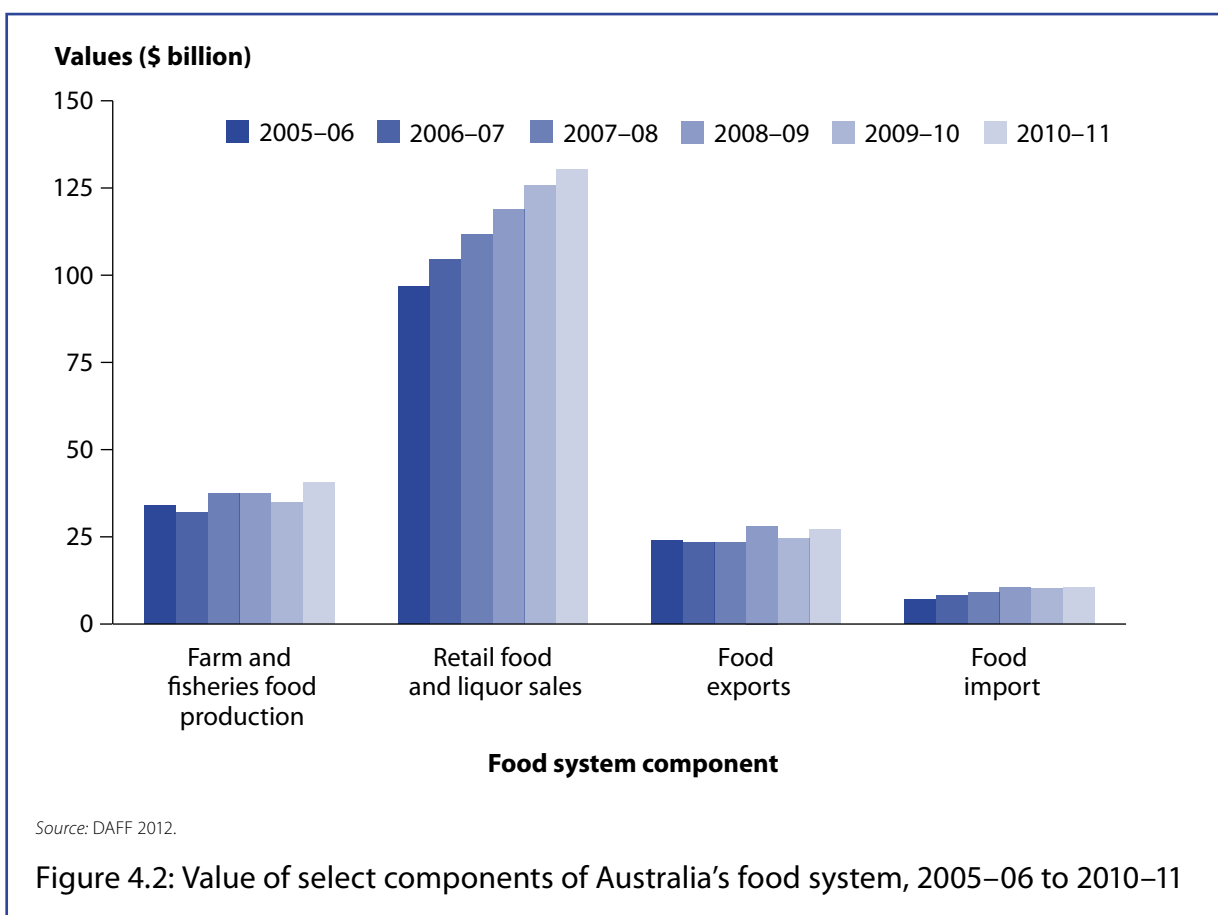
An important distinction between the primary and secondary food industries is the degree of transformation of materials. For example, cattle feedlot operations come under primary production, whereas the slaughter and freezing of carcasses are part of the secondary food industry, as is fruit and vegetable canning. Grape growing and drying are classed as primary production whereas preserving and wine production are part of the secondary food industry (Productivity Commission 2005). Tertiary sector food retailing includes supermarket, grocery stores and specialised food retailing.

4.2 The value of Australia's food system

The food industry is an integral component of the Australian economy. It produces enough food to feed about 60 million people (PMSEIC 2010). The monetary value of select components of the food system is shown in Figure 4.2. Over the past decade, retail food sales have remained the most valuable component and have increased over time. In 2010–11, they increased by 4% to about \$130.4 billion. Farm and fish production was worth \$40.7 billion in 2010–11.

Australia is a major net exporter of food (14th largest in the world), with a surplus of \$17 billion in 2010–11. This surplus has averaged \$16 billion a year over the past 5 years. Food exports are affected by fluctuating import demand, environmental conditions and events such as droughts, floods and fires, and the exchange rate—a stronger Australian dollar makes Australian goods more expensive than those of competitors. The value of food exports has remained steady from 2005–06 to 2010–11 at about \$23.9 billion to \$27.1 billion, while the value of food imports has gradually increased from \$7.1 billion in 2005–06 to \$10.6 billion in 2010–11 (DAFF 2012).





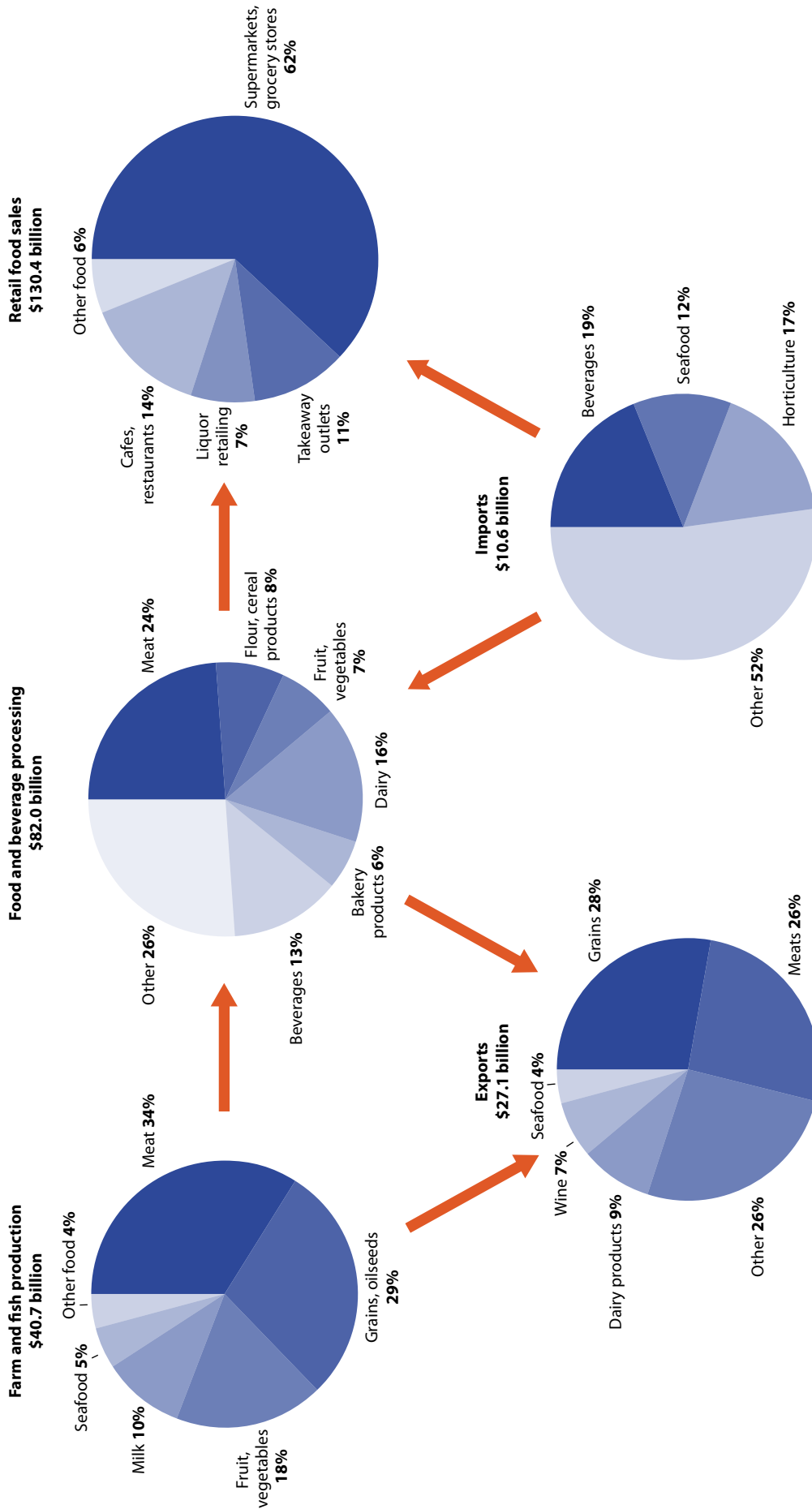
In 2010-11, meat production had the highest value in the farm and fish food production sector (34%), followed by grains and oilseeds (29%) and fruit and vegetables (18%).

In the food processing sector, the most recent official data, at a disaggregated level, is from 2009-10. The 'other food' category, which consists of mainly sugar and confectionery products, was the highest value for the food processing sector (26%). The next highest contributor was the meat processing sector (24%), followed by dairy foods (16%) and beverages (13%).

Supermarkets and grocery stores represent the largest value (62%) to the retail food sales sector, with cafes, restaurants and takeaway food outlets contributing 25% of the total value.

In the imported foods sector, 'other foods' contribute the largest amount (52%) followed by beverages (19%), horticulture (17%) and seafood (12%). 'Other foods' are predominantly processed foods such as bakery products, confectionery, processed meat, dairy, oils and fat.





Source: DAFF 2012.

Figure 4.3: Value chain for food in Australia, 2010–11



4.3 Foods available for consumption

The supply and consumption of a range of food groups in Australia is presented in Table 4.1. The total value in the food consumption component is the amount of food available for use (production plus imports minus exports), while the volume value is the amount available for consumption (production plus imports minus exports and non-human use). For comparison, the amount of food available for consumption per person in Australia is compared with world averages, which are based on the same assumptions.

For some food categories there is a noticeable difference between the total amount available for use and consumption. For example, there were 13,568 thousand tonnes of cereals available for use but only 1,757 thousand tonnes entered the food supply. This is most likely due to the use of cereals for seed and stock feed. Pulses also tend to be used for non-human purposes. In contrast, most of the vegetables, meat, eggs and milk produced are available for consumption.

Compared with average world apparent consumption of various food commodities, Australians have much larger per person availability of alcoholic beverages (308% higher), meat (290%), milk (274%), and animal fats (267%), and moderately higher amounts of sweeteners (196%), vegetable oils (191%), fruit (156%), and seafood (147%). In contrast, the availability of several categories is less than the world average, such as starchy roots (87% lower), vegetables (83%), eggs (75%), cereals (58%), and pulses (33%) (DAFF 2012). Further explanation on the derivation of apparent consumption is in Chapter 9.

The NHMRC food guidance system for Australia outlines recommended food choices for optimal health and prevention of nutrient deficiencies. When the newly devised Foundation Diets food patterns are compared with the current food supply (FAO 2009a), the food categories for which food availability looks slightly inadequate include legumes, non-starchy vegetables and fruit (NHMRC 2010a). It is important to note that more food in these food categories are produced than appear to be available in Australia due to considerable amounts being exported, and these data do not include home-grown produce.





Table 4.1: Supply and apparent consumption of selected foods, annual average, Australia, 2005–07

	Domestic supply			Apparent food consumption			
	Production	Imports	Exports	Total ^(a)	Volume	Per person	
	(kt)	(kt)	(kt)	(kt)	(kt)	Australia (kg)	World (kg)
Alcoholic beverages ^(b)	3,055	168	799	2,539	2,297	111	36
Cereals ^(c)	26,905	340	19,668	13,568	1,757	85	147
Starchy roots ^(d)	1,255	197	57	1,396	1,141	55	63
Sweeteners ^(e)	5,190	166	4,346	1,494	976	47	24
Pulses ^(f)	1,611	12	686	973	33	2	6
Vegetables ^(g)	1,870	380	169	2,081	2,028	98	118
Fruit ^(h)	3,594	748	459	3,883	2,179	106	68
Meat ⁽ⁱ⁾	4,036	134	1,749	2,420	2,399	116	40
Eggs	157	3	1	159	126	6	8
Seafood ^(j)	293	527	103	717	505	25	17
Milk ^(k)	9,933	650	4,958	5,489	4,755	230	84
Vegetable oils ^(l)	329	332	136	522	435	21	11
Animal fats ^(m)	749	54	555	239	168	8	3

(a) Takes account of stock changes.

(b) Wine, beer from barley and other fermented alcoholic beverages.

(c) Wheat, rice (milled equivalent), barley (excluding beer), maize, rye, oats, millet, sorghum and other cereals.

(d) Cassava, potatoes, yams and other roots.

(e) Sugar (in raw equivalent terms from both sugar cane and sugar beet), honey and other sweeteners.

(f) Beans, peas and other pulses.

(g) Does not include starchy roots.

(h) Oranges, mandarins, lemons, limes, grapefruit, other citrus, bananas, apples (excluding cider), pineapples, dates, grapes (excluding wine) and other fruit.

(i) Beef and veal, mutton, goat meat, pig meat, poultry meat and other meat and offal.

(j) Freshwater fish, demersal fish, pelagic fish, other marine fish, crustaceans, cephalopods and other molluscs.

(k) Excludes butter.

(l) From soybeans, groundnuts, sunflower seed, mustard seed, cottonseed, palm kernels, palm, copra, sesame seed, olives, maize germ and other oil crops.

(m) Butter, ghee, cream, raw animal fats, fish body oil and fish liver oil.

Source: DAFF 2012 from Food and Agricultural Organisation FAOSTAT nutrition data.

Care needs to be taken when interpreting data on the available food supply and apparent consumption due to the lack of current knowledge about home consumption, the overall age of the FAOSTAT data, the gross estimations used to estimate food wastage and the resulting FAOSTAT summary data of food availability.

4.4 Primary production

Agriculture is the dominant industry in the total agriculture, forestry and fishing sector. In this sector in 2009–10, agriculture generated the most sales and service income (\$50.4 billion, or 83%), and had the highest total value of labour costs (\$4.6 billion, or 69.5%) (Table 4.2). Agriculture was also the largest contributor to total 'industry value added' (IVA) (\$16.7 billion, or 81.7%), which measures the contribution of businesses in the selected industry to GDP. In comparison, the aquaculture industry contributed 1.9% in sales and service income and 1.5% to IVA (ABS 2011d). In 2009–10, the combined agriculture, forestry and fishing sector IVA was \$20.4 billion (1.6% of GDP) (ABS 2012c).





Table 4.2: Agriculture and fishing industries, selected performance measures, 2009–10

Performance measure	\$ million	Per cent ^(a)
Agriculture		
Labour costs ^(b)	4,636	69.5
Sales and service income ^(c)	50,362	83.0
Industry value added ^(d)	16,681	81.7
Aquaculture		
Labour costs ^(b)	244	3.7
Sales and service income ^(c)	1,157	1.9
Industry value added ^(d)	316	1.5
Fishing, hunting and trapping		
Labour costs ^(b)	269	4.0
Sales and service income ^(c)	1,706	2.8
Industry value added ^(d)	628	3.1
Total agriculture, fishing and forestry		
Labour costs ^(b)	6,675	100
Sales and service income ^(c)	60,688	100
Industry value added ^(d)	20,411	100

(a) Per cent of total agriculture, forestry and fishing industries.

(b) Includes wages and salaries, employer contributions into superannuation, workers compensation premiums/costs, fringe benefits tax paid and payroll tax paid.

(c) Includes rent, leasing and hiring income.

(d) The industry value added represents product value net of intermediate inputs used by the industry.

Source: ABS 2011d.

The agriculture industry

Agriculture has historically played an important role in the Australian economy. The last few decades have brought changes in Australia's agricultural sector, including in the number and size of farms and the composition of activities. As a result, the size and importance of agriculture has declined relative to the rest of the economy. Key factors shaping these trends include changes in consumer demands, government policies, globalisation, technological advances and environmental concerns (Productivity Commission 2005).

The value of production (gross value added or GVA) of the agriculture, forestry and fishing sector has varied significantly over time. While the GVA of this sector grew an average 2.5% a year between 2000–01 and 2010–11, it fell 21% in 2002–03 and 15% in 2006–07, mainly due to the effects of drought on agricultural production. In both cases, this decline was followed by strong growth in 2003–04 and 2008–09 after a recovery in seasonal conditions. Between 2009–10 and 2010–11, GVA in the agriculture, forestry and fishing sector grew 3.6% (ABARES 2012).





Changing farming practices

Over the 20 years to 2002–03, although farm numbers in Australia declined by about one quarter (or almost 46,000 farms), the average size increased by about 23% (from 2,720 to 3,340 hectares). Despite this, smaller farms (such as egg and poultry meat industries that occupy smaller amounts of land) continue to dominate output. Agricultural production has also become more concentrated on larger farms, with an estimated 10% of businesses producing more than 50% of output. Many of the smaller farms tend to be operated by 'lifestyle farmers', prevalent on the fringes of major metropolitan and regional centres (Productivity Commission 2005).

There has also been a change in farming practices, with the use of more intensive production systems and techniques. Also evident are greater diversity in output, with Australian farmers producing a wider range of commodities, crop varieties and livestock breeds for different markets (Productivity Commission 2005).

Workforce participation

The proportion of people working in agriculture has declined steadily from 1992 (4.8%) to 2012 (2.5%) (Table 4.3) when compared to Australia's total workforce. The size of the total agriculture, forestry and fishing industry has also declined (from 5.3% to 2.9%) (ABS 2012d).

In 2012, 87% of people working in the primary food industry were working in agriculture, and this proportion has remained fairly stable since 1992 (Table 4.3). The proportion of the workforce in aquaculture and other fishing is relatively small in comparison (ABS 2012d).

Table 4.3: Employment in the agriculture and fishing industries, as a proportion of the total agriculture, forestry and fishing industry (AFF) and the total workforce (per cent), 1992–2012^(a)

Industry	1992		1997		2002		2007		2012	
	AFF ^(b)	Total ^(c)	AFF ^(b)	Total ^(c)	AFF ^(b)	Total ^(c)	AFF ^(b)	Total ^(c)	AFF ^(b)	Total ^(c)
Agriculture	90.8	4.8	89.5	4.6	87.4	4.1	87.0	3.0	87.3	2.5
Aquaculture	1.1	0.1	1.1	0.1	1.3	0.1	0.8	0.0	1.3	0.0
Fishing, hunting and trapping	2.4	0.1	2.3	0.1	4.0	0.2	1.8	0.1	2.0	0.1
Total AFF	100	5.3	100	5.2	100	4.7	100	3.4	100	2.9

(a) Measured in February each year.

(b) These columns are the percentage of the total agriculture, forestry and fishing industry workforce.

(c) These columns are the percentage of the total Australian workforce.

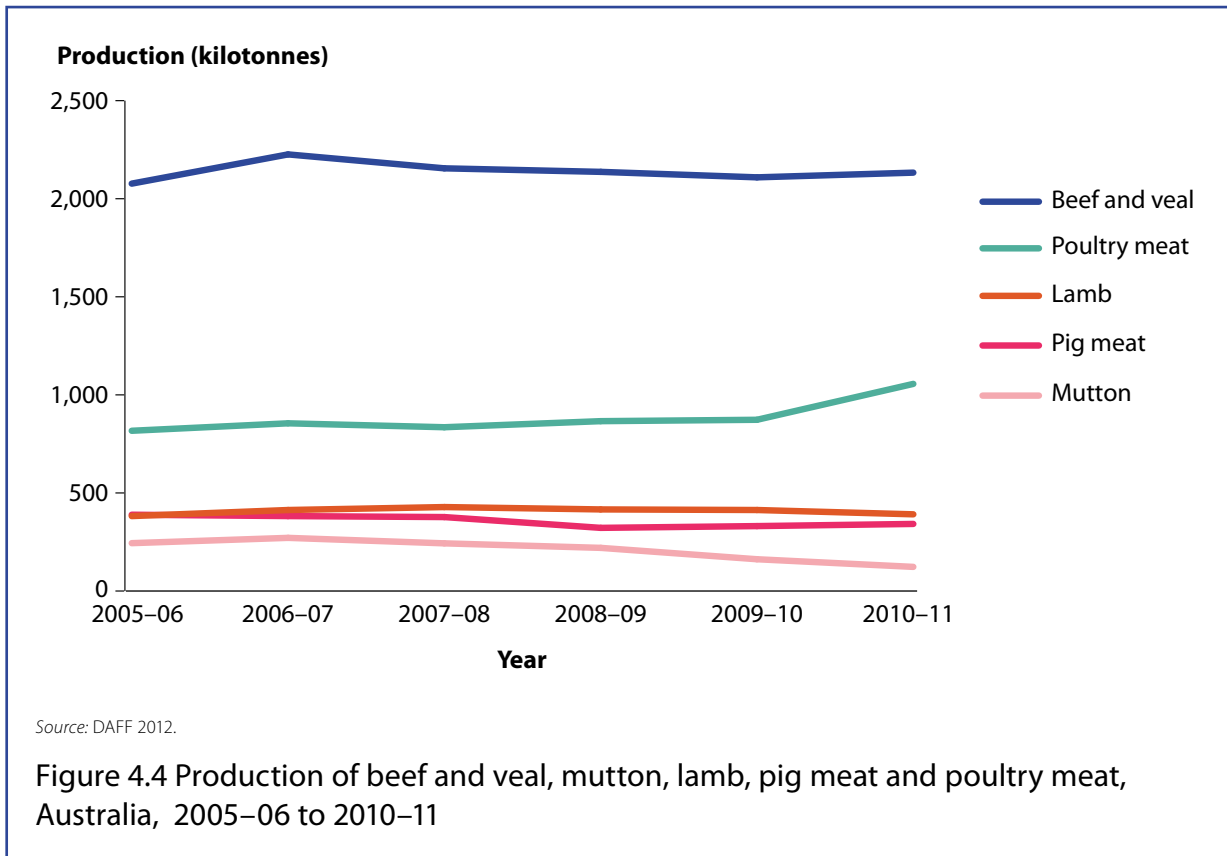
Source: ABS 2012d.

Livestock industry

The livestock industry is the most valuable of all food production industries (DAFF 2011). Agricultural livestock production encompasses only animal numbers, but for the purposes of reporting meat production, data are presented for the number of animals slaughtered and the weight of meat produced, which crosses into the secondary food industry.

Due to the absence of up-to-date data on apparent consumption, estimates of consumption from key industry associations have been provided to give broad generalisations and highlight recent trends. However, care needs to be exercised when making direct comparisons between commodities in case different methodologies have been used to generate these estimates.





Cattle

The beef industry is Australia's largest agricultural commercial activity. Australia is the second largest exporter of beef in the world and the eighth largest beef producer. In 2011, there were about 28.8 million cattle in Australia, with 9% of the total herd used for milk production and 91% for beef production (ABARES 2011). The beef industry produced about 2.1 million tonnes of beef and veal (Figure 4.4) and 44% of all farms were associated with beef production. Australia exported about 64% of its total beef and veal production, generating \$4.2 billion in revenue. Meat and Livestock Australia estimated that, in 2009-10 on average, each Australian ate about 35.7 kilograms of beef (Meat and Livestock Australia 2011).

Sheep

Lamb has become an increasingly important product due to the sheep industry moving its focus from wool production to prime lamb. In 2010, sheep and lamb numbers were about 30 million slaughterings, producing about 0.4 million tonnes of lamb and 0.1 million tonnes of mutton (Figure 4.4) (ABARES 2011). Of this, 46% of all lamb and 92% of all mutton were exported, generating \$987 million and \$486 million respectively. Meat and Livestock Australia estimated that, on average, Australians ate about 10.5 kilograms of lamb and 1.7 kilograms of mutton in 2009-10 (Meat and Livestock Australia 2011).

Chickens

Over recent years, the number of chickens for producing chicken meat has steadily grown, increasing from 433 million slaughterings in 2005 to 512 million in 2010 (ABARES 2011). The chicken industry produced about 1.1 million tonnes of chicken meat in 2010-11 (Figure 4.4). Most of this was for domestic use, with only a small amount exported (about 4%) (ABARES 2011). The Australian Chicken Meat Federation estimated that Australians ate, on average, 37 kilograms of chicken in 2010.



In 2010–11, the total number of chickens for egg production was about 12 million (ABS 2011e). The Australian Egg Corporation reported that retail egg volumes reached 117.5 million dozen eggs in 2010 and this equates to an egg consumption of 192 per person that year (Australian Egg Corporation Limited 2010).

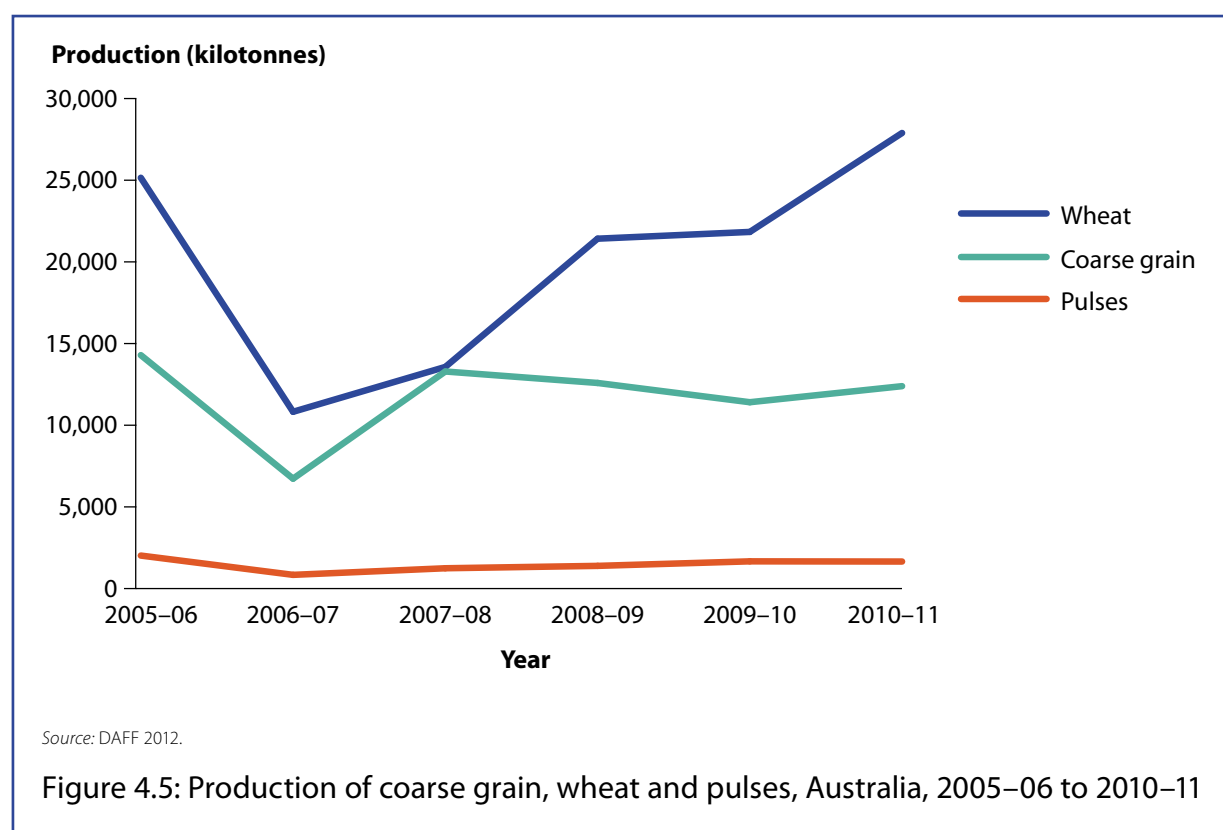
Pigs

Compared with other commodities, pork production is a relatively small component of Australia's agriculture. In 2009–10, pig numbers were about 2.3 million, with about 0.3 million tonnes of pig meat produced (ABS 2011e). Since 2005–06, there has been a 12% decline in pig meat (Figure 4.4). Moderate amounts (about 15%) were exported in 2010–11 and imports have increased by 83% from 2005–06 to 2010–11 (DAFF 2012).

Broadacre

The broadacre, or cropping, industry is the second most valuable food production industry (DAFF 2012) and refers to large-scale cropping operations, including canola, wheat, barley, oats, pulses, sugar cane and rice. Production of wheat has increased back to the levels of 2005–06 (Figure 4.5). The decrease in broadacre crop production in the 2006–07 financial year can be attributed to drought conditions (ABS 2008e). The majority of coarse grain produced, which has fluctuated from 2005–06 to 2010–11, is used for animal feed, with only a small proportion used as food for humans, though this varies from grain to grain and season to season. The difference in wheat use is less pronounced.

Between 2005–06 and 2010–11, wheat exports exceeded the amounts available for domestic use. After wheat exports at 18.6 million tonnes for 2010–11, coarse grains are the next highest export at 5.3 million tonnes. Large amounts of pulses are also exported, with 1.7 million tonnes exported from 2.1 million tonnes produced in 2010–11 (ABARES 2011).



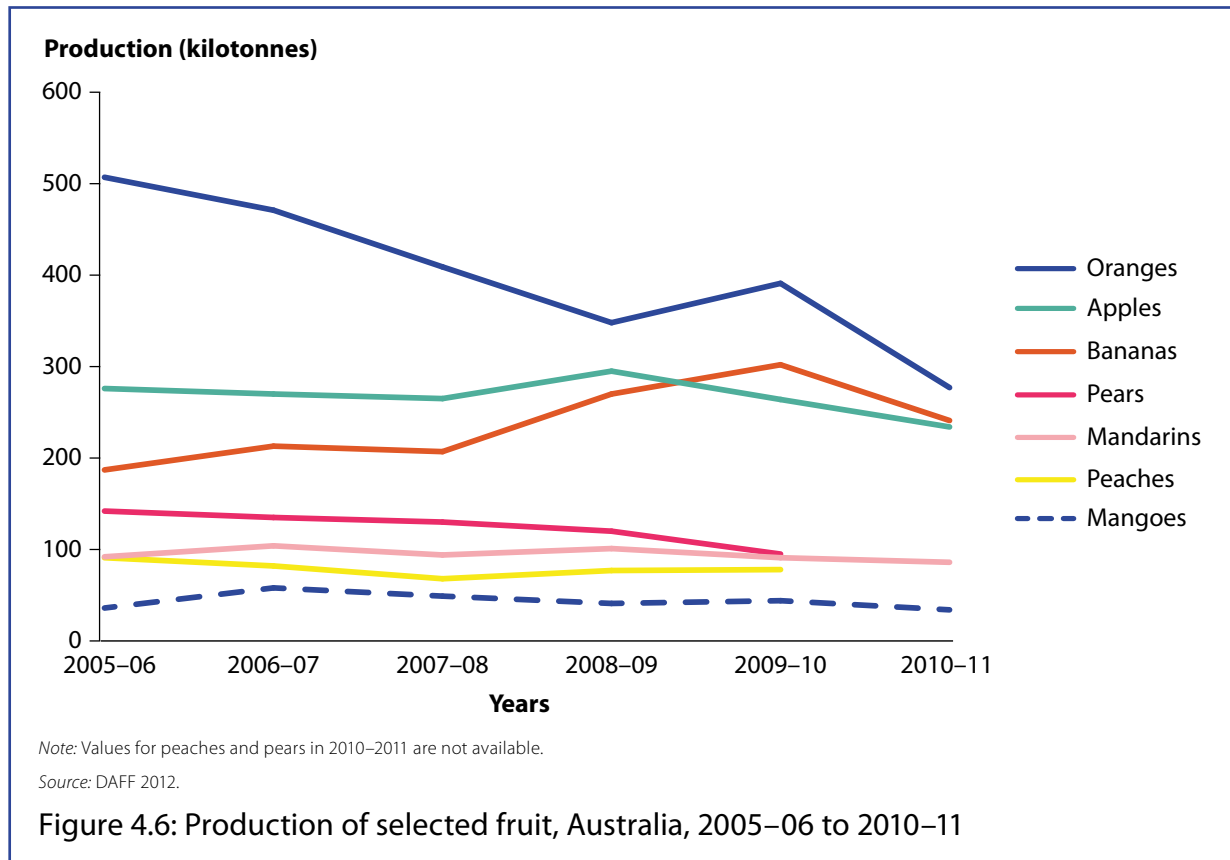


Horticulture

The horticulture industry, which includes fruit, vegetable and nut industries, is the third most valuable food production industry in Australia.

Fruit

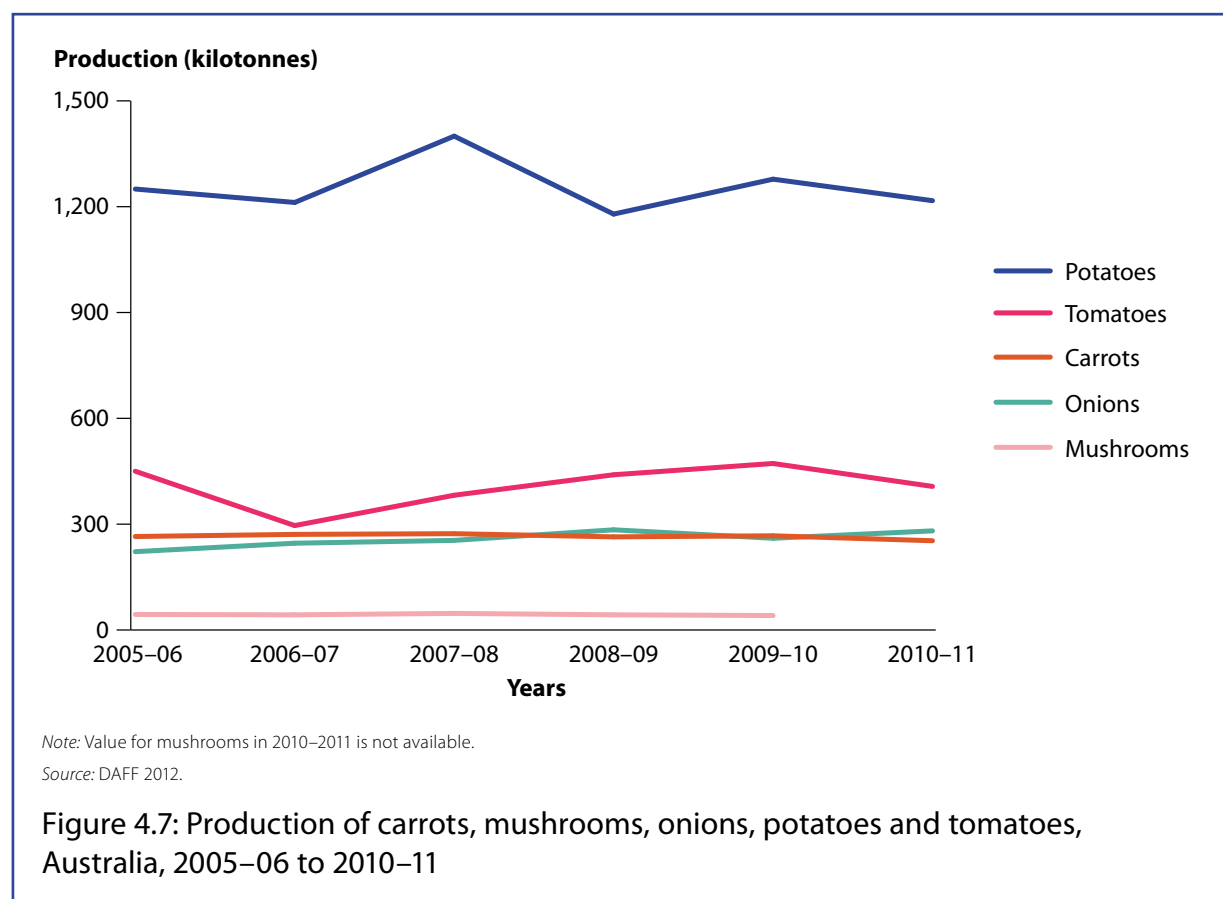
The three main fruit crops produced in Australia are oranges, apples and bananas, followed by pears and mandarins. In recent years, there has been a decrease in fruit production, with orange production decreasing 45% since 2005–06 (Figure 4.6).





Vegetables

Data are available on a select range of vegetable varieties (See Figure 4.7). More tonnes of potatoes are produced in Australia than any other vegetable, followed by tomatoes. Onion production increased (27%) between 2005–06 and 2010–11, whereas the production of mushroom and carrots remained stable and potato and tomato production fluctuated.



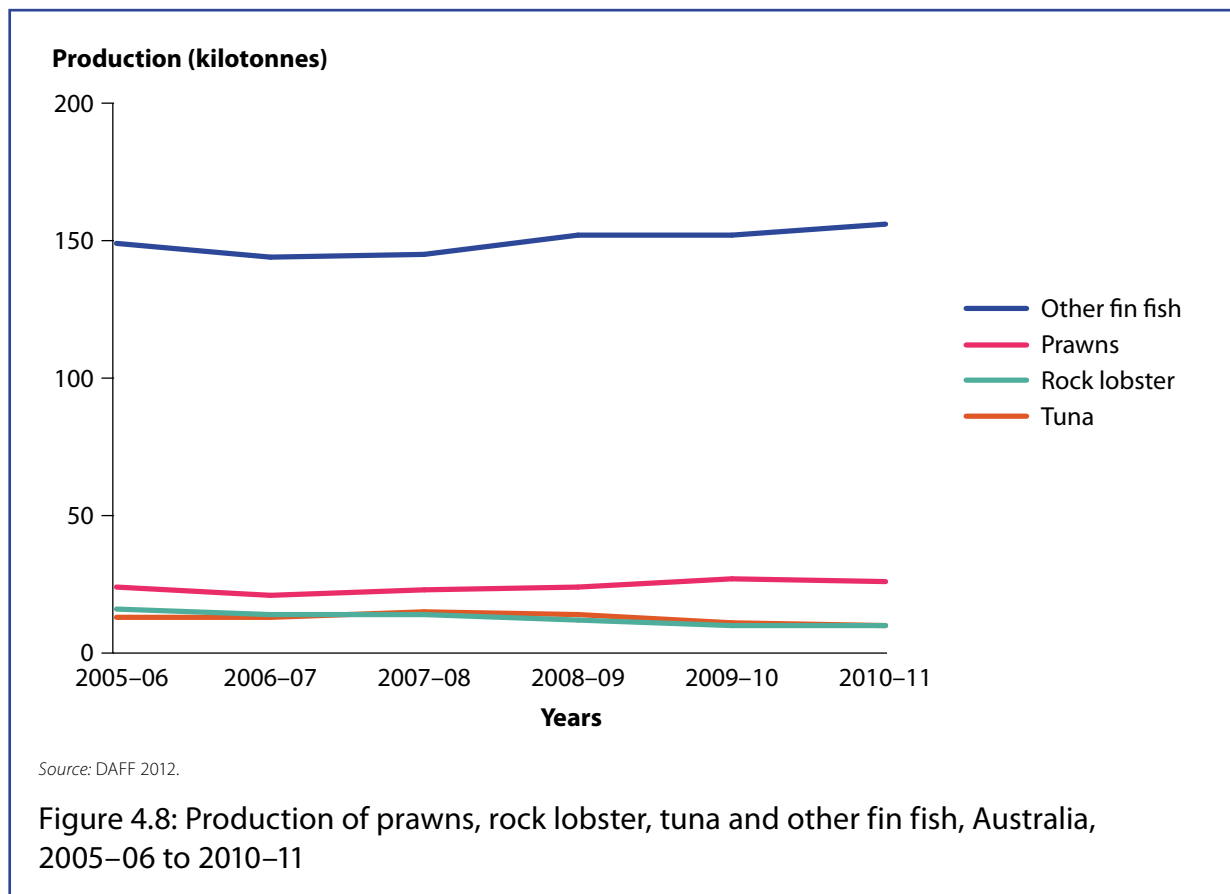


The fishing industry

Australia has the world's third largest fishing zone, with commercial fishing the fifth most valuable industry in Australia, behind beef, wool, wheat and dairy (DAFF 2012). On the world stage, even though Australia commercially harvests a large area, it only ranks 52nd in the world in terms of volume of fish landed. However, it is one of the largest producers of abalone and rock lobster, as it focuses on high value export species. In total, there are about 600 marine and freshwater species caught and sold for local and overseas consumption. Aquaculture, which is an alternative to traditional commercial fishing methods, is one of the fastest growing rural industries, with more than 60 species being farmed (DFAT 2008c).

Between 2005–06 and 2010–11, production of other fin fish increased by 5% but that was after a drop in production during 2006–07 and 2007–08. The production of prawns has remained stable over the last 6 years but the production of rock lobster and tuna has declined by 38% and 23% respectively (Figure 4.8).

Between 2003–04 and 2010–11 about 66–80% of the lobster catch entered the export market. Almost all of the tuna catch was exported, with 3–6 times the amount of tuna exported as imported (ABARES 2011).





4.5 Food production methods

The following production methods are becoming more prominent and offering alternatives to more mainstream food production processes.

Organic and biodynamic

The basic principle of organic farming is to achieve high yields and food of high nutritional quality without using artificial fertilisers or synthetic chemicals. Biodynamic agriculture is similar, with some additional requirements for preparing the soil and growing conditions (DAFF 2004).

Organic foods are gaining in popularity in Australia and becoming more common on supermarket shelves (DAFF 2004). Since 2000, the value of the Australian organic industry has more than doubled, recording more than \$400 million in retail sales in 2006. The range of products is continuing to expand, driven by increasing consumer demand. The most important sectors are beef and horticulture (Australian Government Trade Commission 2010).

The first Australian standard for organic and biodynamic food for sale in Australia was released in October 2009 (AS 6000–2009 Organic and biodynamic products). Before this, organic and biodynamic products were certified by the seven different certifying bodies using a standard developed for the export market. Each body had its own variations to the standard and its own certifying logo.

The new voluntary Australian standard outlines the minimum requirements to be met by growers and manufacturers who wish to label their products as 'organic' or 'biodynamic', starting with production and including preparation, transportation, marketing and labelling. With a consistent national approach, consumers are able to choose products labelled as complying with AS 6000. The Organic Federation of Australia, the peak body for the Australian organic sector, supports the development of a national organic mark to identify products that conform to the Australian Standard. Further information is available from the Organic Federation of Australia's website: <www.ofa.org.au>.

Many producers and companies promote the benefits of organically produced food over conventionally produced food. Recent systematic reviews have compared the nutritional content and health implications of organically and conventionally produced food and found no difference (Dangour et al. 2009; Dangour et al. 2010). However, these reviews focused on the nutritional content of foods and did not examine the contaminant content or environmental effects of organic and conventional agricultural practices.

Natural

Food producers are increasingly marketing their products as containing only 'natural' ingredients. The term 'natural' is considered a food descriptor. The use of food descriptors on food labelling and in advertising must be in accordance with the Australian Consumer Law which prohibits actual or potential misleading or deceptive representations about food (Office of Legislative Drafting and Publishing 2011). For further information, refer to the Australian Competition and Consumer Commission (ACCC) guideline for the food and beverage industry on food descriptors, which includes some guidance on the appropriate use of 'natural': <www.accc.gov.au/content/item.php?itemId=771468&nodeId=303812cdfa698071341bf9f1ac983066&fn=Food%20descriptors%20guidelines.pdf>.





Biotechnology

Biotechnology is a broad term used to describe the application of biology in industrial processes such as agriculture and food manufacture (Biotechnology Australia 2005). While it may sound like a new term, biotechnology has been used for many centuries. Traditional forms include:

- the use of naturally occurring yeasts in the fermentation of beer, wine, bread and cheese
- cloning plants from cuttings
- plant breeding by cross pollination
- animal breeding using selection techniques (ACIL Tasman 2008).

Modern biotechnology involves the application of scientific techniques to living organisms or their products to develop new products or services (ACIL Tasman 2008). Examples include genetic modification (GM), DNA sequencing, cell and tissue culture engineering and the use of enzymes and bacteria in a wide range of applications (ACIL Tasman 2008; Biotechnology Australia 2005).

Genetic modification

GM is a form of biotechnology that has been controversial in recent years. This process involves taking a single or multiple genes with desirable characteristics from a plant or animal and inserting them into another plant or animal of a different species (Biotechnology Australia 2005). Alternatively, some genetic traits are created by silencing a gene rather than introducing a gene. The aim of genetic modification in agriculture and food production is to enhance the quality of the output; for example, to develop a drought-tolerant variety of wheat that produces a higher yield, or a fruit variety with higher levels of certain nutrients.

The Office of the Gene Technology Regulator (OGTR) assesses the potential environmental risks associated with the release of GM organisms in Australia under the *Gene Technology Act 2000*. Future GM crops in Australia may include those that are better adapted to environmental stresses such as drought, frost, acid soils and salinity, or with increased resistance to pests and diseases (Glover et al. 2005).

GM foods are regulated by FSANZ through Standard 1.5.2—Food Produced Using Gene Technology. The two provisions in the standard are pre-market approval and mandatory labelling requirements. Pre-market approval includes a food safety assessment to ensure that approved foods are as safe as conventional foods already in the food supply (FSANZ 2008b). This means that food produced using gene technology, other than a substance regulated as a food additive or processing aid, must not be sold or used as an ingredient or component of any food unless it is listed in the Standard and complies with any specified conditions.

All applications for GM food must be assessed by FSANZ. To date, foods containing GM soybean, canola, corn, cotton, rice, lucerne, potato and sugar beet have been approved (FSANZ 2012b). Some examples of GM foods are corn plants with a gene that makes them resistant to insect attack, and soybeans with a modified fatty acid content that makes the oil better suited for frying.

GM foods, ingredients, additives or processing aids that contain novel DNA or protein that has come from an approved GM food must be labelled with the words 'genetically modified'. Labelling is also required when genetic modification has resulted in an altered characteristic in the GM food, such as a change in the nutritional components in the food compared with the non-GM form. There are some exemptions to the GM food labelling requirements—foods that do not need to be labelled include highly refined foods, such as sugars and oils, where the process has removed DNA and protein from the food, including novel DNA and novel protein (FSANZ 2012c).





Nanotechnology

Nanotechnology is the process of controlling the size and shape of materials at the atomic and molecular scale. The term generally applies to deliberately engineered matter less than 100 nanometres in size, much smaller than human cells, bacteria and viruses (FSANZ 2008c).

Traditional foods already incorporate nanoscale particles but, to date, there have been no requests made to FSANZ to use engineered nanoscale particles in food (FSANZ 2011a). Given the advances in the field of nanotechnology, there may be applications in food in the future; for example, the production of filters to eliminate contaminants and bacteria from drinking water, and food packaging that absorbs oxygen in the air that enters the package to help prevent the growth of harmful bacteria (FSANZ 2008c).

Biofortification

Biofortification is a process where staple food crops are grown with enhanced micronutrient value either by breeding for higher uptake efficiency or fertilisation (Lyons et al. 2004). This process is particularly suited to developing countries where nutritional deficiencies are widespread. There has been limited adoption in Australia with selenium-enhanced wheat grown on a small scale.

4.6 Food processing

The food processing industry is an essential component for changing food from the paddock into a form that is suitable, safe and palatable for human consumption.

The industry

Food processing is the largest manufacturing industry in Australia. In 2009–10, compared with other manufacturing industries, the food, beverage and tobacco manufacturing industry generated the highest sales and service income (\$91.9 billion, or 24%) (Table 4.4). This industry group also had the highest labour costs (\$13 billion, or 22%) of the manufacturing industries. Of these income and cost figures, the food product manufacturing industry, a subset of the food, beverage and tobacco manufacturing industry, generated \$74.1 billion in sales and service income (19% of total manufacturing) and spent \$10.7 billion (18% of total manufacturing) on labour costs (ABS 2011d).

IVA is a measure of output that is potentially comparable across countries and economic structures. In 2009–10, the food product manufacturing industry achieved the highest IVA (\$16.8 billion, or 17% of total manufacturing), followed by machinery and equipment manufacturing (\$10.6 billion, or 11%), fabricated metal product manufacturing (\$10.6 billion, or 10%) and beverage and tobacco manufacturing with \$6.6 billion (ABS 2011d) (Table 4.4).

With more than 25% of the total manufacturing industry workforce, the food, beverage and tobacco manufacturing industry is the largest employer in this sector (Table 4.5). However, this represents only 2% of the total Australian workforce. While the number of people employed in the food product manufacturing industry has increased by 10% since 1992, the total workforce has increased by 50% over the same period. This may relate to technology improvements in the manufacturing industry.





Table 4.4: Food, beverage and tobacco manufacturing, selected performance measures, 2009–10

Performance measure	\$ million	Per cent ^(a)
Food product manufacturing		
Labour costs ^(b)	10,726	17.7
Sales and service income ^(c)	74,128	19.4
Industry value added ^(d)	16,832	17.4
Beverage and tobacco manufacturing		
Labour costs ^(b)	2,318	3.8
Sales and service income ^(c)	17,770	4.7
Industry value added ^(d)	6,609	6.8
Food, beverage and tobacco manufacturing		
Labour costs ^(b)	13,044	21.5
Sales and service income ^(c)	91,898	24.1
Industry value added ^(d)	23,441	24.2
Total manufacturing^(e)		
Labour costs ^(b)	60,641	100.0
Sales and service income ^(c)	381,165	100.0
Industry value added ^(d)	96,809	100.0

(a) Percentage of total manufacturing.

(b) Includes wages and salaries, workers compensation premiums/costs and employers contributions into superannuation. Includes capitalised wages.

(c) Includes rent, leasing and hiring income and other royalties income.

(d) The industry value added represents the value added by an industry to the intermediate inputs used by the industry. IVA is the measure of the contribution by businesses in the selected industry to GDP.

(e) The total manufacturing industry comprises food, beverage and tobacco; textile, clothing and footwear; wood and paper products; printing, publishing and recorded media; petroleum, coal, chemical etc.; non-metallic mineral products; metal products; machinery and equipment; other manufacturing.

Source: ABS 2011d.





Table 4.5: Employment in the food, beverage and tobacco manufacturing industries, as a proportion of the total manufacturing industry and the total workforce (per cent), 1992–2012^(a)

Industry	1992		1997		2002		2007		2012	
	Manuf. ^(b)	Total ^(c)	Manuf. ^(b)	Total ^(c)	Manuf. ^(b)	Total ^(c)	Manuf. ^(b)	Total ^(c)	Manuf. ^(b)	Total ^(c)
Food product	17.5	2.4	16.1	2.1	18.6	2.1	19.0	1.7	21.9	1.7
Beverage and tobacco	2.2	0.3	1.7	0.2	2.3	0.3	3.3	0.3	4.1	0.3
Food, beverage and tobacco	19.6	2.7	17.8	2.3	20.9	2.3	22.3	2.0	26.1	2.1
Total manuf.	100	13.6	100	13.0	100	11.1	100	9.1	100	8.0

(a) Measured at February each year.

(b) These columns are the percentage of the total manufacturing industry workforce.

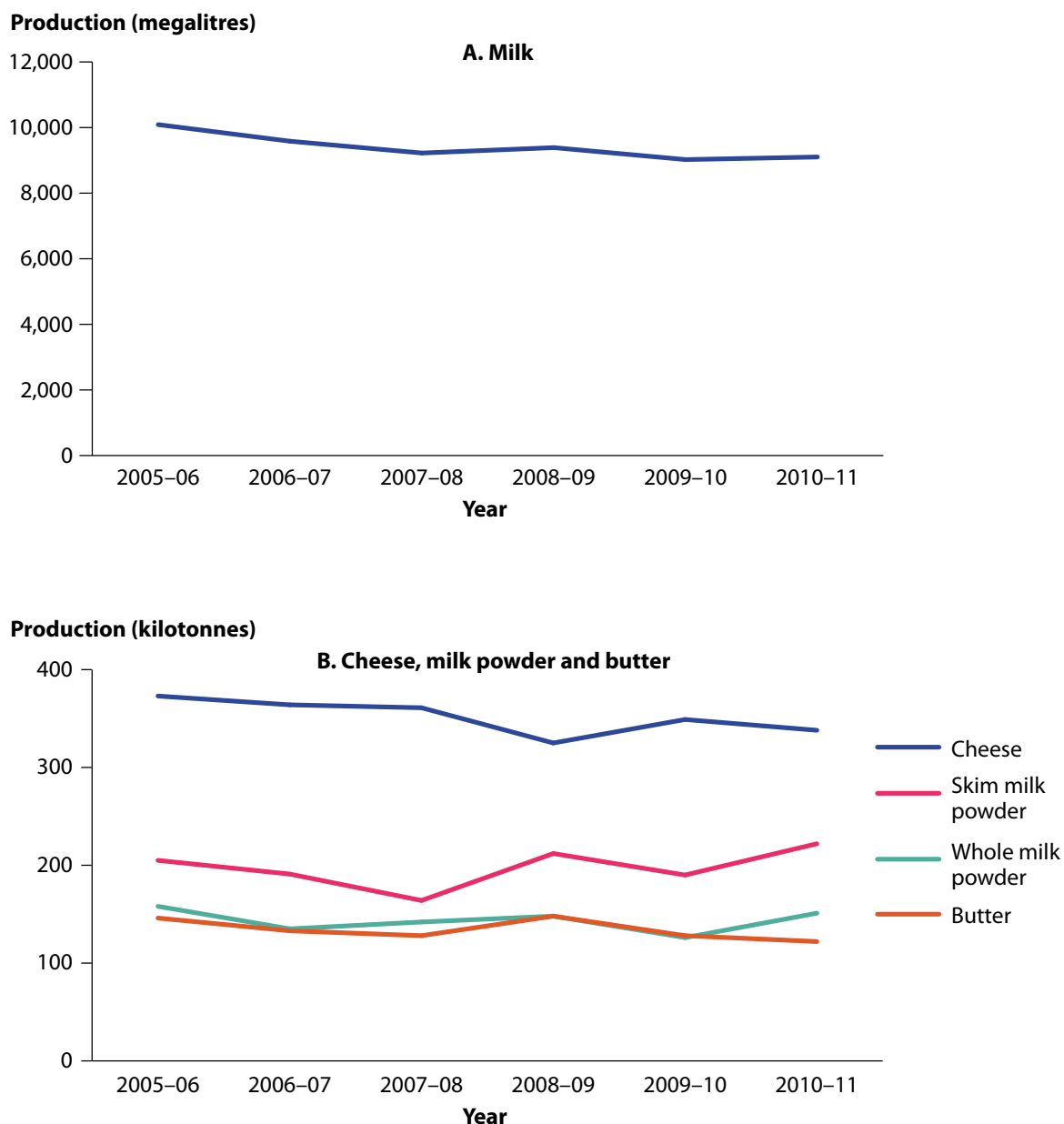
(c) These columns are the percentage of the total Australian workforce.

Source: ABS 2012d.

Dairy

The dairy industry is Australia's third largest rural industry and a major regional employer. In 2009–10, about 45% of milk produced was exported. The industry provides milk mainly for drinking but also for the production of cheese, skim and whole milk powders and butter (Dairy Australia 2011). From 2005–06 to 2010–11, milk production decreased by 10%, with an associated decrease in the production of butter (16%) and cheese (9%). Whole and skim milk powder production has fluctuated over the same period (Figure 4.9). During this time, exports of butter, skim and whole milk powders fluctuated from year to year. For other milk products, such as cheese and fresh milk, exports decreased by 19% and 10% respectively, but imported cheese increased by 20% (DAFF 2012).





Source: DAFF 2012.

Figure 4.9: (A) Production of milk and (B) Production of cheese, milk powder and butter, Australia, 2004-05 to 2009-10

Food imports and exports

The value of Australia's food exports and imports increased between 2000-01 and 2010-11, which may in part be due to the changing value of the dollar (Table 4.6). In 2010-11, the value of Australia's food exports was almost 2.5 times the value of food imports. However, there are differences in the balance of imports versus exports across the commodity groups. Australia exports a greater proportion of dairy products and this was also the case in 2000-01. In 2000-01, the value of fruit and vegetable product imports was 33% higher than exports, but this greatly increased in 2010-11 with imports 160% higher.





Australia has continued to export more flour mill products than it imports, although this is not the case for cereal food and baking mixes. In 2000–01, the value of exported cereal food and baking mixes was almost 3 times the value of imported products. However, in 2010–11 increased imports and decreased exports resulted in the value of imports in this subcategory being 11% less than exports.

From 2000–01 to 2010–11, the value of sugar exports continued to be higher than imports. However, the value of imported confectionery and soft drink, cordial and syrup has increased significantly over this period. While these data do not relate to apparent consumption, either the cost of these imported items has risen greatly, or their local manufacturer has declined, or Australians potentially have access to more confectionery, soft drink, cordial and syrup.

Table 4.6: Food imports and exports, 2000–01 and 2010–11 (\$ million)

Commodity	Imports		Exports	
	2000–01	2010–11	2000–01	2010–11
Dairy				
Milk and cream processing	37	72	1,550	1,107
Ice cream	0	44	34	33
Other dairy products	261	578	1,486	1,184
<i>Total</i>	298	694	3,070	2,323
Fruit and vegetables				
<i>Total</i>	754	1,486	567	572
Flour mill and cereal food				
Flour mill products	77	48	207	344
Cereal food and baking mixes	196	523	544	614
<i>Total</i>	273	572	751	958
Bakery products				
Bread, cakes and pastry products	92	222	12	22
Biscuits	82	338	73	134
<i>Total</i>	174	560	85	155
Other food				
Sugar ^(a)	12	125	1,236	1,420
Confectionery	224	547	261	252
<i>Total</i> ^(b)	876	2,196	2,584	3,031
Beverage and malt				
Soft drink, cordial and syrup	405	818	45	61
<i>Total</i>	832	2,048	2,136	2,485
Total food and beverages^(c)	4,648	10,613	24,025	26,994

(a) Includes ABARES estimates where ABS confidentiality restrictions apply.

(b) Includes foods not classified elsewhere.

(c) Not all food categories were included in the table.

Sources: ABARES 2001, 2011.





Nutrition and food processing

Food can undergo a variety of treatments to extend shelf life and create a product suitable for consumption, including canning, freezing, cooking, salting, smoking and milling. This increases food consistency and also assists with marketing, distribution and transport, helping to extend seasonal availability of many foods. New technologies continue to emerge, such as chilled ready-to-cook foods (fresh pasta, soups and noodles) and shelf-stable products (ultra-high heated milks and juices). Some of these processes affect the nutrients in food.

Nutrient changes

Food preservation processes aim to extend shelf life by removing or destroying the level of toxins and microbes that cause spoilage, for example, pasteurisation of milk. Processes that subject foods to high levels of heat, light, and/or oxygen cause the greatest nutrient losses (Henry & Heppell 2002). Nutrients can also be washed out of foods by fluids introduced during cooking.

Canning and freezing can result in nutrient loss, particularly vitamin C, in fruits and vegetables due to the heating process (Prochaska et al. 2000). However, by the time they are consumed, fresh, frozen and canned fruit and vegetables may be nutritionally similar, depending on post-harvest handling and processing treatments (Rickman et al. 2007). Frozen vegetables that are picked and frozen within hours of harvest often contain more nutrients than fresh vegetables that have been stored for several days before use (British Nutrition Foundation 2000).

Milling wheat into flour results in the loss of nutrients, including thiamin, riboflavin, vitamin B6, folate and biotin (Reddy & Love 1999). Rice is milled to remove the inedible protective outer husk, making edible brown rice, which retains the rice germ and outer bran layers. Further milling produces white rice, which has a lower protein, fibre and vitamin content.

Alternatively, some food processing methods improve the nutritional value of certain foods. Severe heat treatment destroys trypsin inhibitors (which reduce the availability of trypsin, an enzyme essential to human nutrition). For example, heating soy products to a high temperature deactivates the trypsin inhibitor.

Food processing frequently involves the addition of fat, sugar and or salt, which can change the nutrient and energy density of the food.

Food fortification

Food fortification is the deliberate addition of one or more micronutrients to correct or prevent a demonstrated deficiency and provide a health benefit. Voluntary fortification is where food manufacturers choose to fortify particular foods, in response to permission outlined in food law. Mandatory fortification is where governments legally oblige food producers to fortify particular foods or categories of foods with specified micronutrients (Allen et al. 2006).

Permissions and requirements for food fortification are outlined in the Code that is developed and administered by FSANZ (FSANZ 2012b). While most of the voluntary vitamin and mineral permissions are in Standard 1.3.2—Vitamins and Minerals (Table 4.7) (FSANZ 2012c), manufacturers are also permitted to voluntarily add certain vitamins to other foods as outlined in the relevant commodity standard in the Code.

Mandatory fortification

To address specific public health nutrition concerns in Australia, the Code requires the mandatory fortification of bread-making flour with folic acid and thiamin and requires the use of iodised salt for making bread. In addition, edible oils and spreads (margarines) must be fortified with vitamin D. Further discussion of mandatory fortification is in 'Section 8.1—Nutritional status'.





Voluntary fortification

The food industry uses voluntary fortification permissions to varying degrees. Breakfast cereals are one of the main categories where vitamins and minerals are added (FSANZ 2012d). The range of nutrients added to cereals includes thiamin, riboflavin, niacin, folic acid, vitamin C, vitamin E, iron, calcium and zinc. The most popular added vitamins and minerals are thiamin, riboflavin, niacin, folic acid and iron, with most of the fortified cereals containing at least these five nutrients. Both branded and supermarket own brand cereals are fortified, ensuring equity in access across different population groups. These fortified products carry various nutrition content claims and the influence of these on people's purchasing decisions is discussed in 'Section 5.5—Information and marketing'.

Fortification of food groups in the Australian food supply

A wide range of foods on the market have added vitamins and minerals:

Bread

As part of the mandatory fortification requirements, all wheat-based bread, except organic, is made with flour fortified with thiamin, folic acid (folate), and iodised salt (as a source of iodine). Iron is the main nutrient added to bread on a voluntary basis, with the market share held by branded companies.

Margarines and oil spreads

Apart from the mandatory addition of vitamin D to margarines and oil spreads, some manufacturers, primarily of major brands, choose to add vitamins A and E.

Fruit juice, fruit drinks

Most packaged fruit juice and fruit drinks contains added vitamin C. A number of fruit juices, typically the more expensive brands, also contain other added nutrients, such as folic acid, vitamin A and less often, added calcium.

Formulated beverages

One of the most recent additions to the vitamin and mineral fortification Standard is the permission to fortify water and juice-based beverages with a range of vitamins and minerals. These include products such as vitamin waters, formulated beverages or fitness/sports waters.

Soy beverages

Because soy beverages are usually consumed in place of dairy milk which is a key source of calcium, most contain added calcium to assist with meeting nutritional requirements. Other nutrients added can include thiamin, riboflavin, vitamins A and B12, and magnesium.

Formulated supplementary foods

Under the Code, a formulated supplementary food is specifically designed as a supplement to a normal diet to address situations where intakes of energy and nutrients may not be adequate to meet an individual's requirements. There are a select number of milk-type products on the market that are fortified with added nutrients, for example, vitamin D, iron and zinc, with folic acid added less often. In addition, a select range of fruit and vegetable juice-type products contain added vitamins and minerals including iron and vitamin E.





Table 4.7: Voluntary vitamin and mineral fortification permissions, as outlined in Standard 1.3.2 of the *Australia New Zealand Food Standards Code*

Food type	Food	Vitamin and mineral permissions
Cereals and cereal products	Low fat/low sugar biscuits	Thiamin, riboflavin, niacin, vitamin B6, vitamin E, folate, calcium, iron, magnesium, zinc
	Bread	Thiamin, riboflavin, niacin, vitamin B6, vitamin E, iron, magnesium, zinc
	Breakfast cereals	Carotene forms of vitamin A, thiamin, riboflavin, niacin, vitamin B6, vitamin C, vitamin E, folate, calcium, iron, magnesium, zinc
	Cereal flours	Thiamin, riboflavin, niacin, vitamin B6, vitamin E, folate, iron, magnesium, zinc
	Pasta	Thiamin, riboflavin, niacin, vitamin B6, vitamin E, folate, iron, magnesium, zinc
Dairy products	Dried milks	Vitamin A, riboflavin, vitamin D, calcium
	Modified milks and skim milk	Vitamin A, vitamin D, calcium
	Cheese and cheese products	Vitamin A, calcium, phosphorus, vitamin D
	Yoghurts	Vitamin A, vitamin D, calcium
	Dairy desserts	Vitamin A, vitamin D, calcium
	Ice cream and ice confections	Calcium
	Low fat cream and cream products	Vitamin A
	Butter	Vitamin A, vitamin D
Edible oils and spreads	Edible oil spreads and margarine	Vitamin A, vitamin D, vitamin E
Extracts	Extracts of meat, vegetables or yeast	Thiamin, riboflavin, niacin, vitamin B6, vitamin B12, folate, iron
Fruit juice, vegetable juice, fruit drink and fruit cordial	Fruit juice	Calcium, folate, vitamin C, carotene forms of vitamin A
	Tomato juice	Vitamin C, carotene forms of vitamin A, folate, calcium
	Vegetable juice	Vitamin C, carotene forms of vitamin A, folate, calcium
	Fruit and/or vegetable drinks	Vitamin C, carotene forms of vitamin A, folate, calcium
	Fruit cordial	Vitamin C
Analogues derived from legumes	Beverages	Vitamin A, thiamin, riboflavin, vitamin B6, vitamin B12, vitamin D, folate, calcium, magnesium, phosphorus, zinc, iodine
	Analogues of meat	Thiamin, riboflavin, niacin, vitamin B6, vitamin B12, folate, iron, magnesium, zinc
	Analogues of yoghurt and dairy desserts	Vitamin A, thiamin, riboflavin, vitamin B6, vitamin B12, vitamin D, folate, calcium, magnesium, phosphorus, zinc, iodine
	Analogues of ice cream	Vitamin A, riboflavin, vitamin B12, calcium, phosphorus
	Analogues of cheese	Vitamin A, riboflavin, vitamin B12, vitamin D, calcium, phosphorus, zinc, iodine
Analogues derived from cereals	Beverages	Vitamin A, thiamin, riboflavin, vitamin B6, vitamin B12, vitamin D, folate, calcium, magnesium, phosphorus, zinc, iodine
Formulated beverages	Beverages	Folate, vitamin C, carotene forms of vitamin A, niacin, thiamin, riboflavin, calcium, iron, magnesium, vitamin B6, vitamin B12, vitamin D, vitamin E, iodine, pantothenic acid, selenium

Source: FSANZ 2012b.





Formulated caffeinated beverages

Manufacturers are permitted to voluntarily add certain vitamins that meet the requirements of the Food Standards Code to formulated caffeinated beverages. In 2003, the Australia and New Zealand Food Regulation Ministerial Council (the Ministerial Council) issued a Policy Guideline on the Addition of Caffeine to Foods (DoHA 2003). Since then, the number and variety of products on the market containing caffeine has increased. There is some public concern that this change may be associated with increased dietary exposure to caffeine, particularly among children, which may have implications for individual and population health. The Legislative and Governance Forum on Food Regulation has agreed to undertake a full review of the policy guideline on caffeine, including examining current research on its health effects, changes in the international market and regulatory approaches in other countries (FSANZ 2011b).

Sugar substitutes

Intense sweeteners and polyols are added to foods to replace the sweetness normally provided by sugars without contributing substantially to available energy. They have a relative sweetness many times that of sugar so can be used in much smaller amounts. Intense sweeteners approved for use in Australia and New Zealand include alitame, acesulfame potassium (Ace K), aspartame, cyclamate, neotame, saccharin, sucralose, steviol glycosides and thaumatin (FSANZ 2011c). Polyols (also known as sugar alcohols) include substances such as sorbitol, mannitol and isomalt. These provide less energy than sucrose (FSANZ 2012b), and can be used to replace some of the 'bulk' missing when sugar is removed from a product. Sugar substitutes are generally found in soft drinks, cordials and confectionery.

Trans fatty acids

Trans fatty acids, a type of unsaturated fat, are found naturally in products such as meat and milk, and are also formed when liquid vegetable oils are processed for use as fat spreads or shortening for baking, or in deep-frying. There is evidence that intake of *trans* fatty acids increases the amount of low density lipoprotein (LDL) cholesterol in the blood, a key indicator for heart disease. (FSANZ 2009a). *Trans* fatty acids may also decrease levels of high density lipoprotein (HDL) cholesterol—the 'good' cholesterol which is thought to lower levels of LDL cholesterol. The WHO recommends that no more than 1.0% of daily energy intake should come from *trans* fatty acids.

In 2007, dietary modelling estimates showed that Australians consumed on average 0.6% of their daily energy intake from *trans* fatty acids. Naturally occurring *trans* fatty acids from animal products contributed about half the total intake (FSANZ 2007a). Despite this, industry has voluntarily reduced *trans* fatty acid levels in processed and fast foods to reduce intakes across the population.

In 2009, a second review was undertaken to assess the effectiveness of these non-regulatory measures to reduce *trans* fatty acids in the food supply (FSANZ 2009a). It found that more than 90% of Australians had intakes below 1% of their total energy intake, therefore meeting the WHO recommendation. Intake of manufactured *trans* fatty acids has declined by 25–45% compared with levels before 2007, reflecting the effectiveness of current industry initiatives (FSANZ 2009a). *Trans* fatty acid intake estimates were, on average, 0.5% of total energy intake.





4.7 Food safety

Food safety has traditionally referred to conditions and practices that preserve the quality of food to prevent contamination and foodborne illness. In recent times, the definition of food safety has been considered more broadly to reflect a food supply that promotes health and wellbeing and minimises the risk of diet-related disease in the longer term. However, this section focuses on the management of microbiological, chemical and physical hazards throughout the supply chain to ensure a safe food supply.

Food safety can be affected anywhere in the food chain, from production, processing, packaging and transport to storage. Foodborne illnesses affect consumers and the wider community in a variety of ways, including through medical expenses, lost productivity and a reduction in overall health. A preventive approach to food safety throughout the food chain ensures that risks to public health are addressed. This builds consumer confidence and protects Australia's reputation in international trade.

The Australia New Zealand Food Standards Code outlines various requirements that food producers, manufacturers and suppliers must follow to ensure a safe food supply while minimising the impost on food businesses. FSANZ works with government, industry and consumer stakeholders to develop primary production and processing standards that identify points in the food chain where hazards are introduced, rather than relying on solving a problem at the end of the process. Australia-specific food safety standards in the Code provide a national approach to help businesses to control hazards that can arise during production, manufacture, transportation and handling. These include general food hygiene practices, requirements for premises and equipment, and specific programs for riskier foods and vulnerable populations.

The states and territories enforce the standards and DAFF Biosecurity has operational responsibility for the inspection and sampling of imported food.

In recognition of the importance of consumer behaviour in food safety, FSANZ has information to help consumers prepare, eat and store food safely. This is available on the FSANZ website (FSANZ 2012e). Food Safety Week, conducted annually by the Food Safety Information Council, raises awareness and disseminates information about food safety, with a particular focus on vulnerable populations in the community (FSIC 2011).

Monitoring and surveillance

FSANZ conducts monitoring and surveillance activities in collaboration with the states and territories and DAFF Biosecurity to ensure that existing food regulatory measures provide adequate protection of consumer health and safety. FSANZ coordinates the Australian Total Diet Study (ATDS) about every 2 years. Formerly known as the Australian Market Basket Survey, the ATDS estimates consumers' dietary exposure (intake) to pesticide residues, contaminants and other substances (FSANZ 2011d).

Under the Code, businesses are required to have a system in place to ensure the efficient and effective recall of unsafe food. FSANZ's role is to coordinate at a national level the distribution of recall information to state and territory authorities, other government agencies and industry. A food incident is defined as 'any situation within the food supply chain where there is a risk, potential risk or perceived risk of illness or confirmed illness associated with the consumption of a food or foods' (DoHA 2010).





In 2007, health ministers endorsed the first National Food Incident Response Protocol (the Protocol) to maintain an effective system for the management of national food safety incidents. The Protocol formalises current arrangements between agencies and defines roles and associated responsibilities required during the response to a national food incident. Since late 2006, 14 incidents have been coordinated under the Protocol. An example of one of these incidents (melamine in dairy products from China) is in Box 4.1.

Box 4.1: Melamine

In 2008, a number of dairy products from China were found to be contaminated with melamine. This involved the deliberate addition of melamine to milk products, ostensibly to boost its protein content. Kidney problems can result from ingestion of high amounts of melamine, which can lead to death (FSANZ 2008d).

FSANZ was responsible for coordinating the Australian response by determining if food in Australia contained Chinese milk products possibly contaminated with melamine. This involved testing of products, monitoring imports and working with food regulators around the world. Some food recalls were undertaken as a precautionary measure but Australia was largely unaffected by this incident (FSANZ 2008d).

Traceability

The ability to trace the movement of food through all stages of production, processing and distribution is an important risk-management tool to ensure a safe food supply. When a potential risk is identified, the food can be traced to its original source to isolate the problem and eliminate or reduce the potential risk to consumers.

4.8 The food retail industry

Australia's grocery retail sector comprises supermarket stores, both large and small, and small specialty stores, such as bakeries, butchers, fruit and vegetable outlets, fishmongers, Asian grocers and delicatessens (ACCC 2008). Many of the supermarket stores offer a one-stop shop for a range of household items, whereas the specialty stores offer a narrower product range.

Australia has one of the most concentrated retail food sectors in the developed world. The two major supermarket chains, Coles and Woolworths, jointly have almost 80% of the packaged grocery market. In contrast, in the United States, the two major supermarket chains (Wal-Mart and Kroger) have 20% market share and in the United Kingdom the top five chains have about 80% market share. Coles and Woolworths have progressively increased their market share from 35% in 1975 to 79% in 2009 (NARGA 2010). Despite this, an analysis by the ACCC considered that the market share of consumer expenditure on grocery items by Coles and Woolworths (79%) was overstated and more likely to be 55–60%, due to limitations in the data collection methodology (ACCC 2008).

In terms of store numbers, Coles and Woolworths have about one-third of the total number of supermarkets in Australia (Figure 4.10). ALDI operates in Victoria, New South Wales, the Australian Capital Territory and Queensland, and has about 6% of supermarkets across Australia. Franklins has recently been bought by Metcash, which also supplies the Independent Grocers of Australia (IGA) chain (Retail World 2011).





Independent supermarkets are an alternative to the major supermarket chains, and these generally operate on a small scale. They include IGA, Foodworks, Tasmanian Independent Retailers and SPAR Australia (Retail World 2011). Other options include speciality retail grocery outlets—using ABS data the ACCC (2008) estimated there were about 22,000 such stores in Australia. Caution needs to be exercised when comparing store numbers because although independents have 57% of the grocery stores in Australia, they hold less than 20% of the market share. Many of these independents serve small regional and remote communities and therefore have smaller stores than those in larger urban areas.

From 2007 to 2011, the number of Woolworths supermarkets increased by 4% but the number of Coles stores fell by 2% (Table 4.8). In contrast, the number of ALDI supermarkets grew by 26% and IGA by 9% (Retail World 2011).

In 2009, another player entered the food retailing sector—Costco Wholesale Corporation is an international chain of membership warehouses offering a range of items in addition to groceries. The warehouses generally service small to medium businesses, but individuals can also become members. The first store in Australia opened in Melbourne in August 2009 and further stores have opened in Sydney and Canberra.

Coles and Woolworths offer online shopping with associated delivery. Data from Roy Morgan Research's Single Source Survey indicate that Australians have been slow to take up this service. In a 2009 study, a very small proportion of the population (only 1.2% in the year to June 2009) regularly bought groceries online (Roy Morgan Research 2009a). This is expected to rise with increasing Internet usage, including via an expanding range of devices, notably smart phones, tablets and Internet-connected televisions.

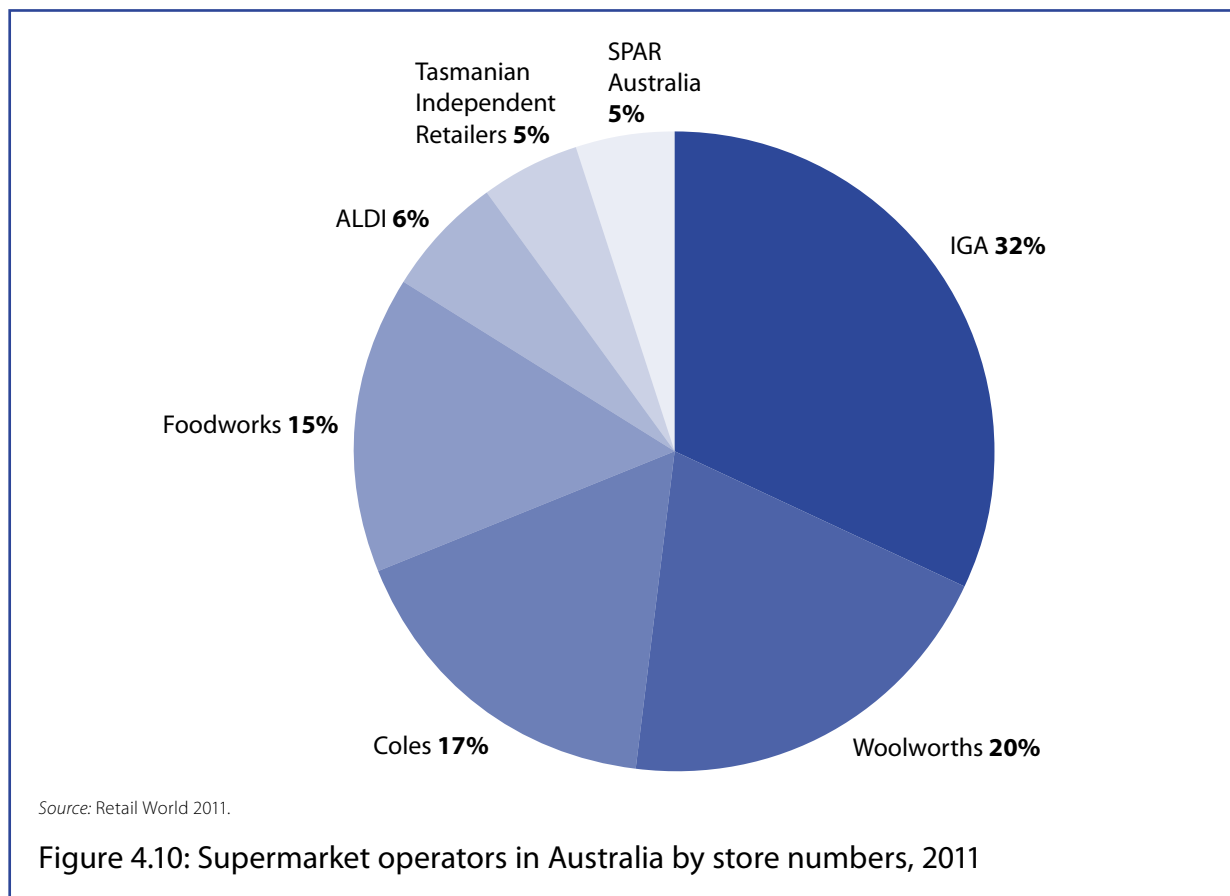




Table 4.8: Number of supermarket stores across Australia, 2007–2011

Chain	2007	2009	2011
ALDI	212	251	267
Coles ^(a)	753	763	741
Woolworths ^(b)	810	823	840
IGA ^(c)	1,278	1,354	1,369
Foodworks ^(d)	678	651	636
Tasmanian Independent Retailers	229	229	226
SPAR Australia ^(e)	230	217	217

(a) Coles comprises Coles, Bi-Lo and Pick 'N Pay.

(b) Woolworths comprises Woolworths, Safeway, Food for Less, Flemings and Woolworths Metro.

(c) IGA comprises Foodland IGA, Supa IGA, IGA/IGA Everyday and IGA Express/Friendly Grocer.

(d) Foodworks comprises Foodworks branded and non-branded stores.

(e) SPAR Australia comprises SPAR Supermarket, SPAR Express, 5-Star, 5-Star Supermarket, 5-Star Handimart and Affiliate/Independent supermarkets.

Source: Retail World 2011.

Speciality food outlets

While there is growth in the supermarket sector, specialty delicatessens, fishmongers, butchers and fruit and vegetable shops are still popular among shoppers, with retailers often marketing their produce as 'local' and 'seasonal'—attributes of increasing appeal to consumers.

Farmers' markets

Concerns about food miles, a belief in the freshness and quality of the products sold, and a desire to support local producers and economies (often in preference to large supermarket chains) has led to a renewed interest in farmers' markets (Coster 2004; Guthrie et al. 2006). These markets operate at a fixed public location in local communities, and provide an avenue for farmers and food producers to sell their products directly to consumers. Fresh fruit and vegetables, jam, baked goods, meats, poultry and eggs are the products most frequently sold (Coster 2004). Sales of these and other products are estimated to be worth about \$80 million each year (Coster & Kennon 2005).

The Australian Farmers Market Association (AFMA) was formed to help information exchange and policy coordination, and to assist with the formation and promotion of farmers' markets across Australia. AFMA's website lists more than 150 markets across Australia (Australian Farmers' Markets Association 2011) but this may be an underestimate.

Pricing policies

A two-tiered approach is used to set prices at Coles and Woolworths. The first level is based on head office setting standard shelf prices and promotional offers for each store. These prices are determined by supply, freight, and store operating costs, prices of other major grocery chains and the number of local competitors. This can mean varying prices for the same product across stores. The second level allows store managers to reduce prices in a range of circumstances, including clearance of discontinued stock, products approaching their use-by date or in response to local competition (ACCC 2008).





How does ALDI compete?

ALDI stores stock a selected range of 900 products that are chosen based on perceived weekly shopping requirements. This compares with more than 20,000 products stocked in the major chain supermarkets. Because ALDI stores stock a reduced number of brands, they can operate from smaller premises. They also reduce overheads by not undertaking large marketing campaigns. It has been suggested that ALDI was the primary driver for the major supermarket chains introducing a greater range of their own brand labels (ACCC 2008).

Introduction of Costco

Costco prices its goods at between 8% and 15% above cost because the majority of revenue is generated through annual membership fees. As there are so few outlets, the ACCC considers that Costco will have limited competitive constraint on the major supermarkets (ACCC 2008). However, this may change if further outlets are opened.

Competition

Competition can play a role in the price and quality of products available for purchase. The ACCC studied the effect of a competing Coles or Woolworths store on grocery prices. The study found that during 2007, prices at Woolworths stores with a Coles store within 1 kilometre were on average 0.7% lower than prices in stores where there was no Coles store within 5 kilometres. Also, prices at Coles stores with a Woolworths store within 1 kilometre were on average 1.4% lower than prices in stores where there was no Woolworths store within 5 kilometres. The presence of ALDI also has an effect—during 2007, prices at Woolworths and Coles stores with an ALDI store within 1 kilometre were on average 0.7% and 0.8% lower respectively than prices without an ALDI store within 5 kilometres (ACCC 2008). The decision by Woolworths to move towards more uniform pricing is likely to affect the outcome of future studies.

The study also found that independent supermarkets had an effect on prices at Coles and Woolworths, but to a smaller extent than ALDI. Overall, when setting prices, Coles and Woolworths are more likely to be influenced by each other and ALDI than by independent retailers (ACCC 2008).

Food retail statistics

The retail trade industry is comprised of food retailing, motor vehicles and parts, fuel retailing, other store-based retailing, and non-store retailing and retail commission-based buying/selling. In 2007–08, the food retailing industry spent \$9.7 billion on labour costs (26% of the total retail trade) and generated \$81.1 billion in sales and service income (26% of the total retail trade). These figures were second behind other store-based retailing (ABS 2011d).

Of the total retail trade industry, the food retailing sector's workforce is the second largest (32% in 2011), behind other store-based retailing (54% in 2011).

In 2007–08, supermarkets and grocery outlets continued to hold the market share of food sales in Australia at about 61% (DAFF 2012).





Table 4.9: Top 10 ranking grocery departments, by year and total value (\$ billion), 2009–2011

2009 departments	Value (\$ billion)	2010 departments	Value (\$ billion)	2011 departments	Value (\$ billion)
Dairy, chiller	5.8	Dairy, chiller	5.8	Dairy, chiller	5.9
Cigarettes	5.0	Cigarettes	4.8	Cigarettes	5.0
Beverages, cold	3.9	Beverages, cold	4.1	Beverages, cold	4.1
Frozen foods (incl. frozen fish)	2.8	Frozen foods (including frozen fish)	2.9	Frozen foods (including frozen fish)	3.1
Health and beauty	2.5	Health and beauty	2.6	Health and beauty	2.8
Confectionery	2.0	Confectionery	2.3	Confectionery	2.3
Bread, rolls and bakery snacks	1.8	Bread, rolls and bakery snacks	1.9	Bread, rolls and bakery snacks	2.2
Pet needs	1.7	Pet needs	1.8	Smallgoods	2.1
Paper, plastics and foil	1.6	Paper, plastics and foil	1.7	Pet needs	1.8
Beverages, hot	1.3	Beverages, hot	1.3	Paper, plastics and foil	1.7

Source: Adapted from Retail World 2011.

Grocery sales trends

Between 2009 and 2011, six of the top 10 grocery category sales were for food items (Retail World 2011). Dairy products were the highest ranked category over this period, and included milk, cheeses, yoghurt, spreads and dips. Cold beverages, which cover soft drinks, energy drinks, sports drinks and mineral waters, ranked third, followed by frozen foods at fourth. Confectionery items were sixth, and bread, rolls and bakery items seventh. However, data on the sales of fresh fruit and vegetables were not included in this report.

In 2010, a survey of 30,000 shoppers found that the top influences on shopping behaviour included price competition, global economic uncertainty, growing demand for supermarket own brand products, increased importation as a result of the higher Australian dollar and Generation Y preferences.

There has been aggressive pricing competition, particularly between Woolworths and Coles, with the introduction of milk costing as little as \$1 per litre.

Supermarket own brand products (for example, home brand) are becoming more common and popular. In 2008, a survey found that 43% of respondents had bought supermarket own brand products to control their household budgets. In the quarter to June 2008, own brand products achieved 22% of the grocery market (Nielsen 2009). This is expected to increase with growing global economic uncertainty. The survey also found that younger shoppers tended to be less brand-loyal, ate out more often and were more technologically aware. Mobile phone applications are now available to help shoppers prepare shopping lists, and compare the prices and nutritional information of supermarket products.

A more-recent Nielsen survey showed other developments likely to influence shopping trends include self-scanning checkouts, range consolidation, online shopping, loyalty cards, and environmentally-friendly products (Nielsen 2011).



Key points

- In 2009–10, households in the highest income group spent on average three times the amount spent by households in the lowest income group.
- Between 2003–04 and 2009–10, the cost of goods and services (including food) increased 19%, after inflation.
- It is estimated that currently 5% of adults have insufficient food.
- Healthy food is generally less available and costs more in remote areas.

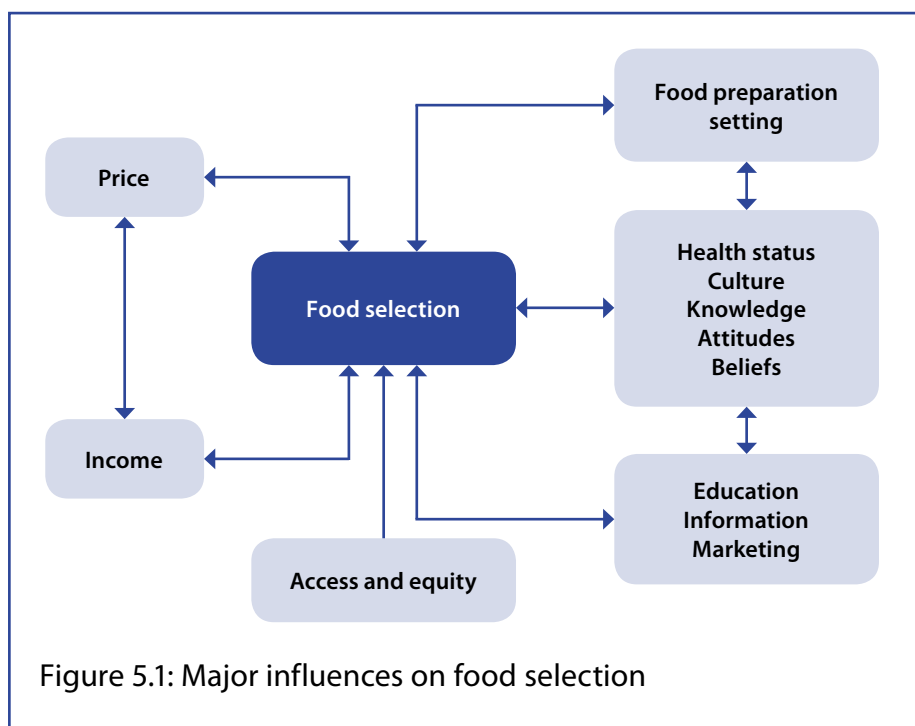
Food selection

5





Food purchases are influenced by income, the price of food and access to, and availability of, food supplies, particularly retail facilities. They are also influenced by people's culture, knowledge, attitudes and beliefs. The food environment, marketing and food labelling also affect food choices (Figure 5.1).

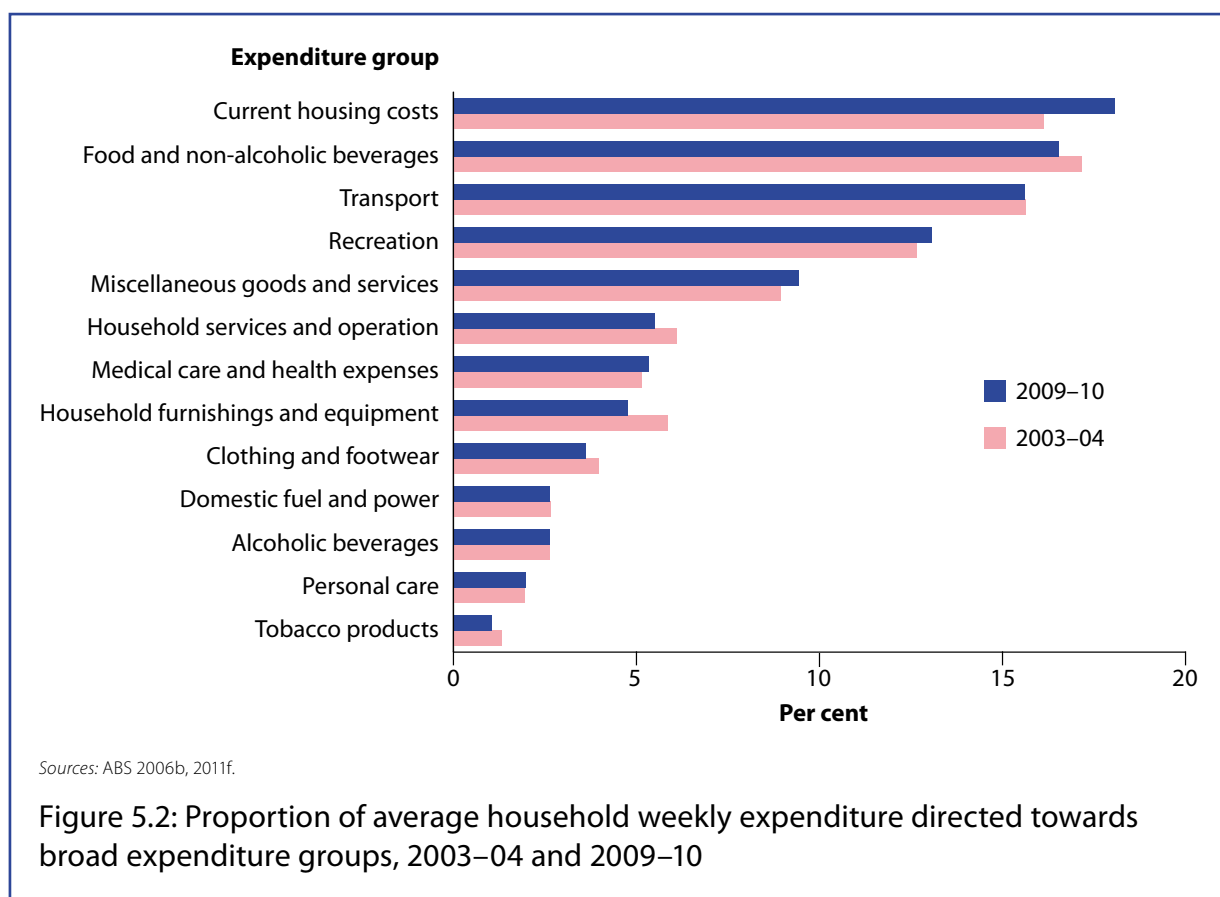


5.1 Household expenditure

In the 12 months to June 2010, Australian households spent an average of \$1,236 each week on goods and services (ABS 2011f). This was an increase of \$343 per week (38%) since 2003–04. After taking account of inflation, as measured by the consumer price index (CPI), the cost of goods and services rose by 19% since the last Household Expenditure Survey in 2003–04. Over the same period, the weekly mean gross household income rose by 50%, noting the size of the average household increased from 2.53 to 2.57 people (ABS 2011f).

In 2009–10, the largest category of weekly household expenditure on goods and services was housing costs, such as rent and mortgage payments, of \$223 (18% on average). Food and non-alcoholic beverages cost, on average, \$204 (17%), while \$193 (16%) was spent on transport. Together, these three categories accounted for half the average weekly household expenditure on goods and services (Figure 5.2).

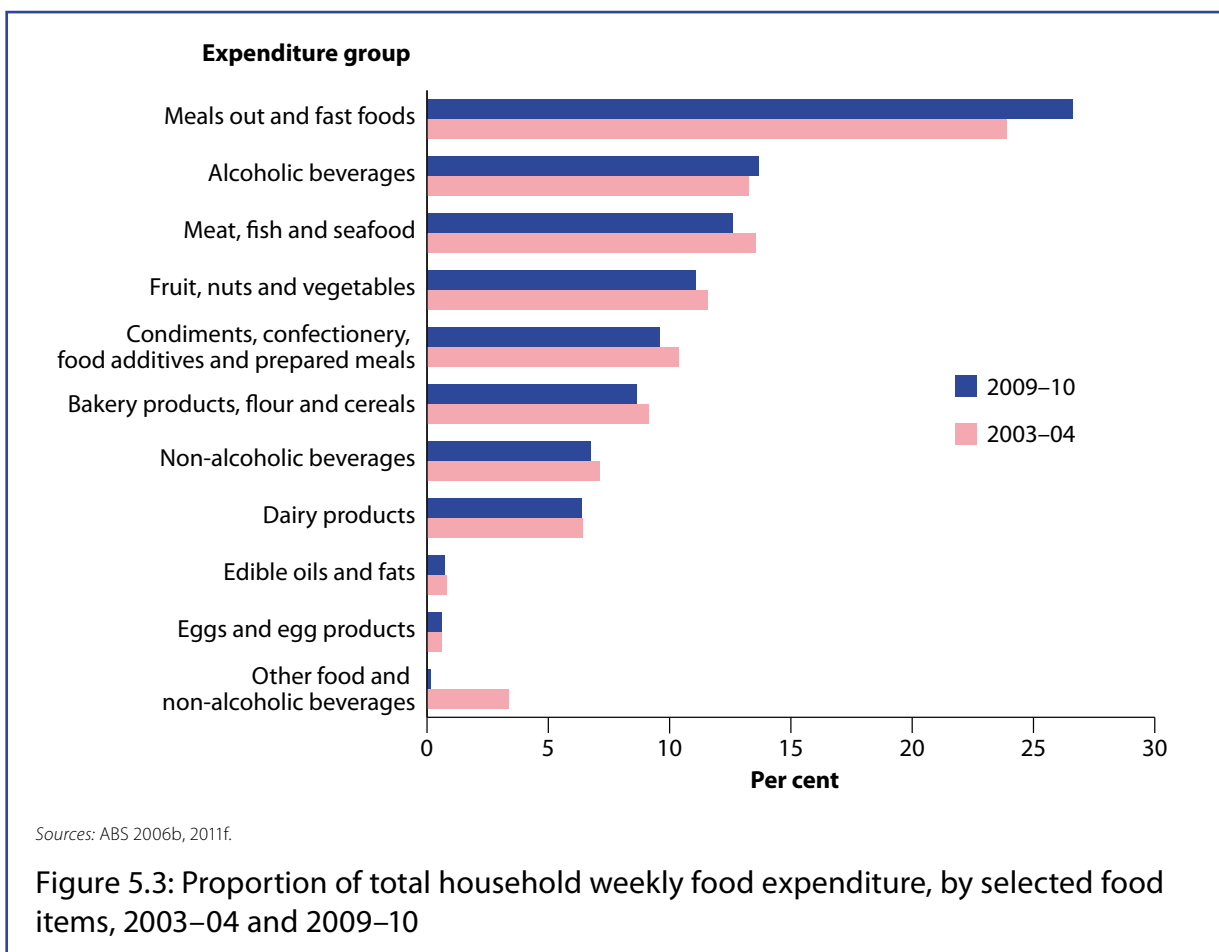




Food expenditure

Food and beverages (both non-alcoholic and alcoholic) comprise about 19% of weekly household expenditure. In 2009-10, Australian households spent an average of \$237 per week on food and beverages compared with \$176 in 2003-04, an increase of 34% (ABS 2011f), though this does not take account of inflation. Food prepared outside the home (meals out and fast foods) was the largest food and beverage expenditure item and averaged \$63 (27%) per week in 2009-10, followed by alcoholic beverages at \$32 (14%), and meat, fish and seafood at \$30 (13%). The average household spent as much on alcoholic beverages per week as on domestic fuel and power. Of the average weekly expenditure on food and beverages, meals out and fast foods rose from \$42 (24%) in 2003-04 to \$63 (27%) in 2009-10, an increase of \$21, not adjusting for inflation (Figure 5.3).





Food expenditure across income levels

Not surprisingly, average weekly expenditure on food and beverages increased as household income rose across all selected food groups (ABS 2011f). Figure 5.4 shows that, in 2009-10, households in the highest income group spent an average of \$389 on food and beverages, or 18% of their total household expenditure. This was about three times the amount spent by households in the lowest income group (\$113, or 20% of total household expenditure).

For both the highest and lowest household income groups, meals prepared outside the home (meals out and fast foods) were the major food expenditure item. In the top income group, the second highest weekly food item was alcoholic beverages, followed by meat, fish and seafood; then fruit, nuts and vegetables. For households in the lowest income group, however, the second largest weekly food expenditure item was meat, fish and seafood; followed by fruit, nuts and vegetables; then alcoholic beverages (figures 5.4 and 5.5).



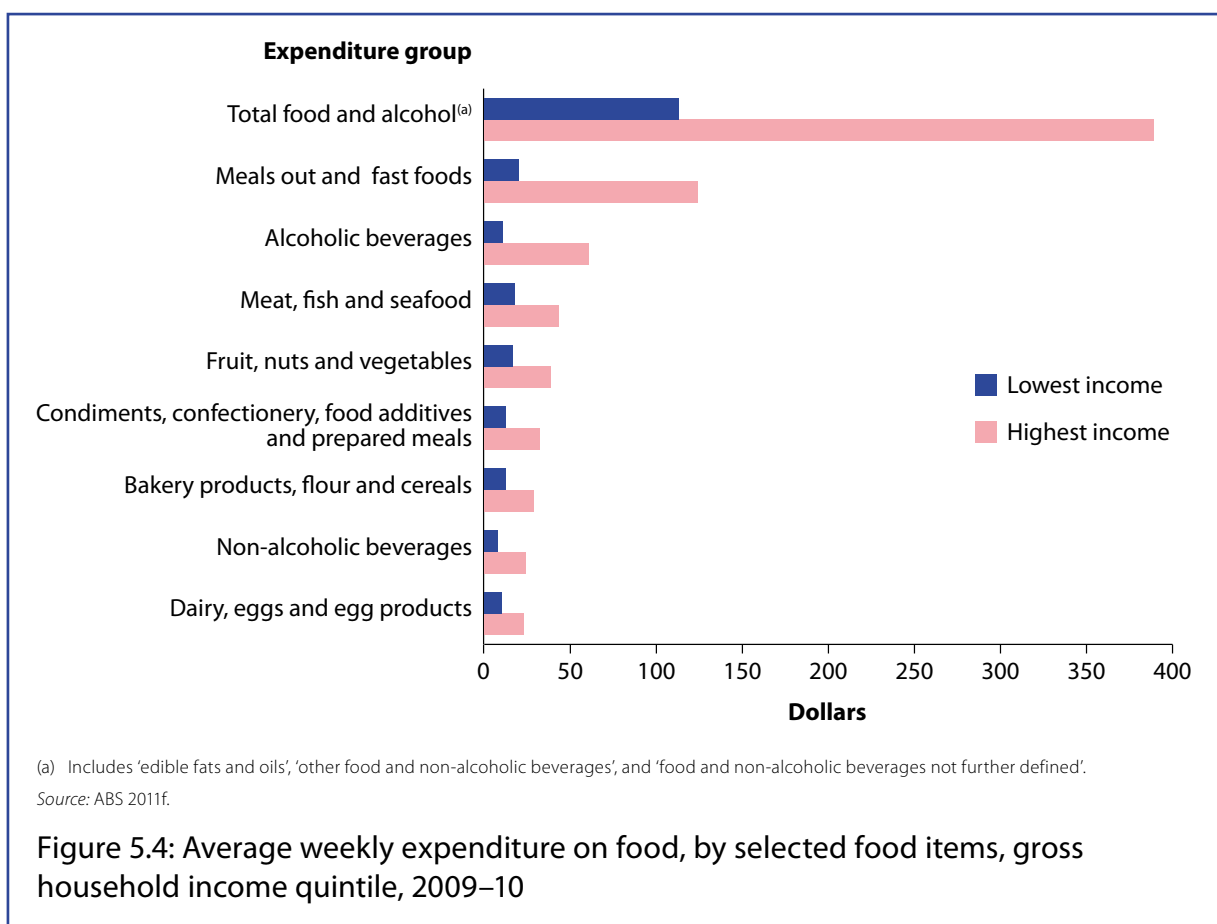


Figure 5.5 shows expenditure trends by household income group for the top five food and beverage categories. The data show two clear trends in expenditure in relation to income. Firstly, for meals out, fast foods and alcoholic beverages—so-called discretionary items—the proportion of weekly expenditure increased with household income. High income households spent \$123 (31%) of their weekly food and beverage expenditure on meals out and fast food and \$61 (16%) on alcoholic beverages, compared with low income households which spent \$20 (18%) and \$11 (9%) on these categories respectively.

Secondly, for more general items, such as meat, fruit and vegetables and prepared meals, the converse was true as the proportion spent increased as household income decreased. For example, low income households spent \$17 (15%) on vegetables and fruit, compared with \$38 (10%) by high income households.





Per cent

35
30
25
20
15
10
5
0

■ Lowest ■ Second ■ Third ■ Fourth ■ Highest

Condiments, confectionery, food additives and prepared meals
Fruit, nuts and vegetables
Meat, fish and seafood
Alcoholic beverages
Meals out and fast foods

Source: ABS 2011f.

Figure 5.5: Proportion of weekly food expenditure spent on the top five food categories, gross household income quintile, 2009–10

5.2 The price of food

Food affordability

ABS data on selected food items included in the CPI provide information on the affordability of food over time (ABS various). After adjusting for overall inflation, between 2003–04 and 2009–10 food prices in Australia increased by about 20%. However, just looking at changes in price does not reveal the whole story. People's capacity to afford food (that is, their income) may vary across time and place. For example, the price of a food item may increase 5% over 10 years, but if a person's income increases by 10% over that same period, then the item becomes more affordable. Furthermore, the average income can vary depending on where in the country someone lives.

CPI data track movements in the retail prices of goods and services commonly purchased by metropolitan households, including food and non-alcoholic beverages. Other goods and services include alcohol and tobacco; clothing and footwear; housing; furnishings, household equipment and services; health; transport; communication; recreation and culture; education; and insurance and financial services.

While the CPI is a useful measure for tracking changes in prices over time, it is subject to price fluctuations caused by disasters, for example, the shortage of bananas after cyclones Larry (in 2006) and Yasi (in 2010). The basket of foods used to calculate the CPI is based on data collected for the Household Expenditure Survey (that is foods commonly purchased) and does not provide information on the cost of a basket of food that would promote health.

Additionally, collection of CPI data is limited to capital cities, and therefore does not reflect the higher cost of food in general, or healthy food in particular, in regional and remote areas of Australia (Queensland Health 2011).





Effect of location on food prices

Various factors play a role in food prices across geographic areas, including supply costs, transport, size and characteristics of demand and local competition (ACCC 2008).

A study by the ACCC found that the prices paid for grocery items at Coles and Woolworths stores varied across the country. Prices were lowest in South Australia and the eastern mainland states and territories (about 1% below the national average) and highest in the Northern Territory (about 4% above the national average). The study also found only small differences in prices between metropolitan and regional supermarkets, with the exception of Western Australia, Queensland and South Australia, where the prices were an average of 1–2% higher in regional supermarkets (ACCC 2008).

The situation is different for independent supermarkets where a relationship between remoteness and grocery prices is evident. Higher prices at independent supermarkets in regional areas are likely to be the result of higher transport costs that operators must recover on an individual store basis. This is not the case in the major supermarket chains, which can balance costs across stores. The smaller population in regional areas results in higher operating costs relative to turnover, and lack of competition is also likely to play a role (ACCC 2008).

As there are few supermarkets in more remote areas and therefore a lack of price competition, strategies to improve the availability and affordability of healthier alternatives are needed to help address the health inequalities experienced by Indigenous Australians living in these areas (Queensland Health 2011).

5.3 Food security

The United Nations World Food Summit of 1996 defined food security as existing 'when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life' (FAO 1996).

Food security is generally thought to have four dimensions:

- *Food availability*—sufficient quantities of food are available on a consistent basis
- *Food access*—sufficient resources are available to obtain appropriate foods for a nutritious diet
- *Food use*—appropriate use, based on knowledge of basic nutrition and care, as well as adequate water, sanitation and food preparation facilities
- *Food stability*—stability of availability and access over time (FAO 2009b).

If one or more of these dimensions does not exist for a person or household (for example, not knowing when or what your next meal will be), it is termed food insecurity. There are considered to be three levels of food security, which lie on a continuum:

1. *Secure*—having continual access to sufficient, safe and nutritious food
2. *Insecure but without hunger*—food is regularly consumed, but there may be intake of food with poorer nutritional quality and occasional meal skipping
3. *Insecure with hunger*—sufficient food to meet nutritional needs or to avoid hunger is commonly not obtained (Burns 2004).





Data on the prevalence of food insecurity are somewhat limited and have been generally gained through population surveys. This can lead to bias in results as portions of the community may be missed (for example, a telephone survey may not be able to access those who are homeless or without a phone), self-reported answers may be inaccurate (for example, people may be unwilling to admit to food insecurity for their family), and the limited questions may be interpreted differently by survey participants (Booth & Smith 2001; Quine & Morrell 2006).

Nevertheless, a number of national and state-based surveys in the last 20 years have estimated that 5–8% of the population had run out of food and were unable to buy more at least one time in the 12 months before the survey (Rutishauser et al. 2001; Centre for Epidemiology and Research 2002; Victorian Department of Health 2011; Lockie & Peitsch 2012).

The four dimensions of food security in Australia

Food availability

Australia is a food secure nation with sufficient food for its population (see Chapter 4). As discussed in Chapter 2, people in many countries suffer both food insecurity and hunger; however, in Australia, this proportion is smaller—the majority of food insecure people (60%) have regular meals, but many of these meals are of poorer nutritional quality (Temple 2008).

While national food availability is not considered to be an issue for the foreseeable future, population growth and climate change may affect future food security. By 2050, Australia could become a net food importer, at least sporadically (PMSEIC 2010).

The other dimensions of food security are more relevant to vulnerable groups in Australia.

Food access

There are many access-related causes of food insecurity, such as poverty, remoteness and limited physical access to food, social isolation, frailness and chronic illness. The effect of these can be cumulative, with affordability (poverty) a common theme.

Food affordability

Poverty is generally defined relative to a 'poverty line', with those having a total income under the poverty line cut-off considered to be living in poverty (Melbourne Institute of Applied Economic and Social Research 2011). In 2006, it was estimated that 2.2 million Australians (11%) had incomes that defined them as living in poverty (Australian Council of Social Service 2011).

Food choice is influenced by store location and the availability, variety and price within stores. A study in Melbourne (Ball et al. 2009) found that, compared with residents of socioeconomically disadvantaged neighbourhoods, people living in more advantaged neighbourhoods had a greater number of supermarkets and fruit and vegetable stores within 2 kilometres of their home. They also benefited from a higher density of fruit and vegetable stores per 10,000 residents and travelled the least distance to their nearest supermarket and fruit and vegetable store. These residents also had access to a greater range of fruits and vegetables, and they tended to spend more on these foods. Most of the groups vulnerable to food insecurity have a high proportion of low-income earners, which limits their food purchasing.

As shown in Figure 5.4, people with the lowest household income spend less on food than those with higher incomes; however, this is still a larger proportion of their income than for those with the highest household income (Burns 2004).





Compared with other Australians, a higher proportion of Indigenous Australians are unemployed or have low incomes, spend a large percentage of their income on food and live in *Very remote* areas (Saethre 2005; Browne et al. 2009). Also, the misuse of substances such as alcohol and tobacco may divert money away from food and other necessities (AIHW 2010b). In 2004–05, about 24% of Indigenous Australians aged 15 and over reported they had run out of food in the previous 12 months (AIHW 2009).

A 2011 Queensland study showed university students were at significant risk of food insecurity, especially those renting or who had low incomes, or who were receiving government assistance. At least 13% of those surveyed experienced food insecurity (Hughes et al. 2011a).

Other examples of affordability causing greater food insecurity come from results of the 1995 National Nutrition Survey, where compared with the overall level of food insecurity recorded for adults (5.2%), higher levels were found in those who were unemployed (11.3%), in the bottom 30 per cent of income earners (10.6%) or on a government pension or benefit (9.0%) (Rutishauser et al. 2001).

Remoteness and limited physical access

The ACCC found that almost 90% of people living in metropolitan areas normally travelled less than 5 kilometres to shop at their regular supermarket. In contrast, almost a quarter (23%) of people living in regional areas travelled more than 10 kilometres (ACCC 2008). A lack of access to transport may limit food choices to smaller local stores with higher prices (SIGNAL 2001).

A study in south-east Melbourne measured access to major supermarkets (indicator for access to healthy, nutritionally adequate and affordable food) and quick service restaurants (indicator for access to unhealthy food) (Burns & Inglis 2007). The majority (more than 80%) of the population were within 8–10 minutes of a major supermarket by car, half were within 8–10 minutes by bus and only 4% by foot. Access to quick service restaurants showed a similar pattern: a short car journey for most (more than 80%) and longer travel times by bus and foot. Quick service restaurants were more accessible to the population from less advantaged areas, while major supermarkets were more accessible to the population from more advantaged areas.

Market basket surveys are undertaken in a number of jurisdictions to monitor various aspects related to food access, namely cost, availability, affordability, variety and quality. These are usually undertaken to monitor differences between locations in terms of remoteness and socioeconomic status.

In general, their findings show an increase in the cost of a healthy diet in more remote areas, particularly *Very remote* areas. In addition, the availability and quality of fresh fruit and vegetables decreases with remoteness. One such survey, the 2010 Queensland Healthy Food Access Basket Survey, which collects data on the cost of a standard food basket across various levels of remoteness, found the cost disparity between healthy items in *Major cities* and in *Remote* areas was much greater than for less healthy choices (energy-dense, nutrient-poor foods) (Queensland Health 2011).

In the Northern Territory, a healthy basket of food cost an average of 29% more in remote areas than in Darwin (Menzies School of Health Research 2008).

Social isolation, frailness and chronic illness

Social isolation refers to those who are missing relationships with family or friends, or who find it more difficult to integrate with the society they are in—for example, recent refugees, people who do not speak English, people who are homeless, or the elderly who live alone.





A study by Gallegos and colleagues (2008) showed that 71% of recently arrived refugees in Perth had reported running out of food for reasons such as: other large bills, poor household or budgeting skills, transport issues or sending money 'home'. Migrants may also experience food insecurity because they fail to take up nutritional options (due to factors such as limited dietary education) when transferring from their traditional diets after relocating to Australia (SIGNAL 2001; Renzaho & Burns 2006).

Data from 2009 suggest about 500,000 people aged 60 and over need assistance with transport or household chores, and about 180,000 with meal preparation—needs which were not always fully met (ABS 2009c). Additionally, older people with a chronic illness who live alone and people with disabilities often face extra costs as a result of their illness or disability. The effects of frailness, chronic illness and social isolation mean many have limited ability to shop for food or to prepare meals, leaving them either suffering from, or at greater risk of, food insecurity (Quine & Morrell 2006).

Food use

Lower educational attainment is linked to disadvantaged populations and food insecurity (Burns 2004; Turrell & Kavanagh 2006). Lack of nutritional, budgeting and planning knowledge and food preparation equipment often predisposes people to waste food and eat poor quality meals that may not meet nutritional requirements (Browne et al. 2009; Burns 2004).

Further, the hypothesis of 'the poor behaving badly' speculates that those with lower levels of education are less likely to follow health recommendations, such as healthy eating (Burns 2004). This is an area where community and government food security programs often focus.

Food stability

The lack of reliable access to food may be constant, cyclical or temporary and linked to specific events or crises such as unavoidable financial hardship (SIGNAL 2001). Events that may affect stability include:

- loss of employment
- social security and pensioner payment schedules
- unexpected, but essential purchases taking priority (for example, replacing a broken refrigerator) (Burns 2004).

Other factors that have the potential to influence food stability (by affecting availability and access) include restructuring of the retail environment, freight costs, and changes to social and economic policy.

Initiatives to address access and equity issues

Government and non-government organisations include food security and equity issues in health and nutrition policies and programs such as *Eat Well Australia* and the Australian Dietary Guidelines. The Australian Government's Closing the Gap strategy aims to reduce Indigenous disadvantage with respect to life expectancy, child mortality, access to early childhood education, educational achievement and employment outcomes, while the *Remote Indigenous Stores and Takeaways Project* aims to improve access to a healthy food supply in remote communities. State, territory and local governments, along with non-government agencies, are also addressing food security issues in their policies and programs.





To address the concern that Aboriginal and Torres Strait Islander people in *Remote* and *Very remote* areas suffer from a lack of affordable, nutritious foods, the Queensland Government developed the 'Nutrition policy for remote retail stores and take-aways' (Queensland Health 2007). One of the objectives is to improve the ability of stores to provide a range of healthy, affordable food of good quality and with reliable supply. This is to be achieved by stores consistently stocking adequate supplies of good quality fresh fruit and vegetables at comparable prices to the nearest regional centre. Stores should also supply a range of other food, including frozen, canned and dried fruit and vegetables, wholegrain and wholemeal bread, wholegrain breakfast cereals and reduced-fat tinned and processed meat.

The Victorian Health Promotion Foundation (VicHealth) has implemented a successful food security program called *Food for All* to improve access to nutritious food that people can store and cook with ease. Eight councils have been funded to offer practical and sustainable initiatives to help residents living in disadvantaged areas obtain regular access to nutritious foods (VicHealth 2008).

A Community Food Forum has been established in the Australian Capital Territory, consisting of individuals and organisations with an interest in improving access to nutritious food for disadvantaged community members. Specific aims include helping to improve food outreach initiatives and maximising opportunities for food choice (ACTCOSS 2012).

Seal (2004) recommended a nationally coordinated program be introduced to monitor the price and availability of healthy food. This could be achieved by using healthy food basket surveys. The benefits of this approach include that it:

- better identifies areas and determinants of food insecurity through representative sampling across geographic and demographic groups
- describes price and availability of healthy food over time
- establishes national reference data for benchmarking at the local level
- enhances capabilities for evaluation of interventions.

The challenge for Australian governments is to make sure food (especially those needed for a healthy diet) is affordable and available for all Australians.

Food insecurity and obesity

Diet-related conditions such as being overweight or obese are not solely related to those who are food secure. A review by Burns (2004) indicated the risk of obesity was 20% to 40% higher for women who experienced (mild to moderate) food insecurity—the level most common in Australia; food insecurity with hunger was associated with thinness.

Socioeconomic concerns such as food security are known to affect food purchasing behaviour. A study by Turrell and Kavanagh (2006) showed disadvantaged people were less likely to purchase products that were high in fibre and low in fat, salt and sugar, and they suggested this may contribute to health inequalities between people living in different socioeconomic areas. Further, people who were dependent on welfare were less likely to buy and eat healthier foods (Kettings et al. 2009), mainly because of the cost associated with buying them. In a 2011 survey of Australians, 13% reported they could not afford to eat nutritionally-balanced meals (Lockie & Peitsch 2012). These findings relate to the hypothesis that people with limited economic resources are more likely to consume cheaper foods that are energy dense and highly palatable, leading to weight gain (Basiotis & Lino 2002; Drewnowski & Specter 2004). Therefore, many people in vulnerable groups may be food insecure, yet overweight or obese.





5.4 Culture, knowledge, health status, attitudes and beliefs

People's knowledge, attitudes and beliefs about food are influenced by their culture, family, peers, food labelling and nutrition information, media and advertising. Food choices and preferences evolve from infancy to old age—shaped by new personal circumstances, exposure to new foods, changing self-image and health awareness and the access and affordability of different food types. Settings where food is eaten also affect what people eat. The reasons why individuals change or adopt new dietary behaviours are numerous and complex. In some circumstances, people will find dietary change difficult to achieve and maintain. Understanding when, how and why dietary changes occur over time (whether or not the changes are lasting) is critical for developing intervention strategies.

Cultural and religious influences

Overseas migration has changed Australia's population. Over recent decades, the composition of the population born overseas has altered while older Australians are more likely to have been born in Europe, and younger Australians are more likely to have been born in New Zealand or Asia (AIHW 2011c). See Chapter 1 for further details.

Australia has become an ethnically diverse nation with migrants from more than 200 countries, although migrants born in the United Kingdom continue to be the largest group of residents born overseas (5.3% of Australia's total population at 30 June 2010) (ABS 2011g). Migrants bring their cultures, language, religions and cuisines, which help them settle in their new country. Equally, some Indigenous Australians have maintained their culture, religious beliefs and strong links to the land.

Family and peer groups

Food is an important part of socialisation and recreation. Accordingly, food preferences and eating behaviours are shaped in the context of many social settings, including the home and social networks. These influences are particularly relevant during childhood and adolescence—life stages where there is increased sensitivity for developing long-lasting food preferences and eating behaviours (Patrick & Nicklas 2005).

Family members can exert a strong influence on children's dietary habits that, in turn, can have a substantial impact on their health status (Story et al. 2002; Cason 2006). As providers of food, parents and carers play an important role in facilitating or limiting access to certain foods in the house. Parental attitudes towards food (for example, preferences towards certain food categories and willingness to try new foods), combined with levels of knowledge, can also shape their children's attitudes and preferences. Food preferences in children as young as 2 have been shown to be closely aligned with mothers' individual preferences (Skinner et al. 2002).

Life events, such as living together, may change the food choices of couples. Partners tend to eat similar types of food and have similar nutritional intakes after marriage (Bove et al. 2003). Dietary changes by one partner (for example, a special low-fat or weight-loss diet) may have spin-off effects that change the diet of the other person. An Australian study of 60 newly married couples found that, while men and women differed in their food concerns, most food choices became more similar after marriage (Craig & Truswell 1994). In this study, wives were more likely to make changes after marriage but eventually this reversed so that husbands were making more changes than their wives. An earlier study suggested that marriage improved the quality of men's diets but that women's diets deteriorated (Worsley 1988).



While family and carers have the strongest influence on children's health, peer groups create norms concerning eating behaviours, particularly as children grow older (Story et al. 2002). There are many normative beliefs (that is, beliefs about what other people think of a particular behaviour) that can influence food preferences and choices in a social setting. For example, it has been suggested that adolescents may be reluctant to eat healthily because they fear appearing weird or different to their friends (Brown et al. 2000). Familiar foods are more likely to be chosen than new foods.

There is some evidence that dietary patterns established during childhood and adolescence influence food choices later in life (NHMRC 2011). As children become adolescents and young adults, they tend to eat takeaway food more often and have breakfast less often. The recent popularity of reality cooking shows and weight-loss programs, especially with young people, suggests an increased interest in food, cooking and health.

Health factors

For all Australians, good nutrition contributes to quality of life, helps maintain healthy body weight, protects against infections, and reduces the risk of chronic disease and premature death. Food choices may be based on health needs rather than preferences. Individuals may adopt a healthier lifestyle to maintain optimal health or to avoid the risk of becoming overweight or obese or developing an illness as they age.

The Australian guide to healthy eating provides detailed information about the foods for different age groups in the population (Smith et al. 1998). Following the Australian Dietary Guidelines can help reduce the risk of developing diet-related diseases.

Overweight and obesity

Successful weight management requires long-term commitment to a healthy lifestyle, which includes generally eating healthy foods and enjoying regular physical activity. A plethora of weight loss diets exists, some promising fast weight loss without a scientific basis. These diets often eliminate entire food groups and do not provide a range of important nutrients. Fad diets may provide short-term results but are difficult to sustain and can cause serious health problems. Weight-loss organisations may offer individual or group support, resources or pre-prepared meals to help clients adjust to smaller portion sizes and healthy choices. Pharmacies, gyms and personal trainers are also sources of advice on weight loss.

Chronic health conditions

Those with a diet-related disease may be advised by a medical or health professional to change their diet in response to a diagnosis of a chronic condition or an acute health crisis (for example, a heart attack) (Murphy et al. 2006; Paisley et al. 2008). Diet is an important component in the management of chronic conditions such as high blood cholesterol, certain allergies, kidney disease and coeliac disease. For example, people with a lactose deficiency need to avoid dairy products and replace these foods with milk substitutes such as soy beverages.

Some people experience adverse reactions to specific foods that may lead to the exclusion or reduction of these foods in their diet to help manage their condition. An Accredited Practising Dietitian can provide expert dietary advice to help individuals with these chronic conditions.





Environmental and ethical factors

Australians are becoming more discerning about food choices, where their food comes from, how it is grown and how it affects their health and environment. Shortages of particular food products (for example, bananas after cyclone Yasi), fluctuating food prices (during drought and after flooding in eastern Australia), and fears about climate change may contribute to greater awareness of the impact of food choices on the environment.

Organic food

People consume organic food for a variety of health and social reasons: it is often perceived to be beneficial to the environment and human health because it does not involve the use of chemicals (Chang et al. 2003). Organics are associated with social benefits including supporting smaller farms and rural communities, and protecting animal welfare and biodiversity. While tests on organic food and food grown in the conventional way show little difference in nutritional value (Dangour et al. 2009), some organic consumers also say the food tastes better.

Although anecdotal evidence suggests organic food is growing in popularity, minimal data are available to show trends in this food preference. In a 2001 telephone survey of 1,200 Australians, 40% of respondents claimed to have consumed at least some organic food in the preceding 12 months, while 8% claimed that more than half of their diet was organic. Organic consumers were more likely to be women, well educated, and at least in the middle income range (Lockie et al. 2002).

While organic products are increasingly stocked by the major food retailers in Australia, they usually sell for higher prices than conventional products. In 2005, the average price premium for a basket of organic food compared with a similar basket of conventional food was 80%. These higher prices are due to the labour-intensive nature of production, smaller yields, dedicated processing, storage and handling systems, and the demand and willingness of consumers to pay for organic products (DAFF 2004).

Vegetarianism and veganism

Vegetarian diets are based on foods derived from plant sources (for example, fruit, vegetables, nuts, grains and seeds) to the exclusion of meat products. While vegan vegetarians consume no food of animal origin, many vegetarians include some animal-based products (for example, dairy products and eggs).

Vegetarianism can be motivated by health, ecological and ethical concerns. Environmental motivations include objections to practices associated with livestock farming, destruction of forests to make room for grazing animals, excess water usage and methane production. There are perceived health benefits associated with vegetarian diets, particularly through increased fruit and vegetable intake and reduced saturated fat intake. Vegetarians also cite animal welfare as an ethical or philosophical motivation for their food choices (Lea 2003).

There are limited data on vegetarianism in Australia. The self-reported prevalence of vegetarianism among Australians aged 19 and over was 3.7% in 1995, as reported by the National Nutrition Survey. Vegetarianism was shown to be more common among women and younger people (ABS 1998). A random survey of 1,202 Australian adults conducted by Newspoll in 2009 found that 5% of respondents reported they were vegetarian and 1% vegan. However, based on the foods they reported eating, only 2% actually ate a vegetarian diet, and only 0.6% a vegan diet (VVSQ 2010).





Ethical consumerism

Ethical consumerism includes selecting foods that involve minimal harm or exploitation of humans, animals and the environment. The rise in this movement has resulted in an increased demand for food that is locally produced, seasonal and has a low environmental footprint (Heij 2005). Food products can either be positively selected for complying with ethical standards or morally boycotted for their failure to do so.

Australians are becoming increasingly aware of the need for more efficient and sustainable agricultural methods and food production processes to conserve limited resources such as land, water and phosphate fertilisers. They are also mindful of the importance of maintaining biodiversity, minimising the carbon footprint and waste, and treating animals humanely. This is demonstrated by the growing popularity of free-range chicken, eggs, meat and pork, despite a price premium. The concept of food miles was developed in the 1990s to help consumers understand the environmental impact of long distance food transportation (Box 5.1).

Box 5.1 Food miles

Food miles is a term used to describe the distance travelled by food products between production and consumption. A study in Victoria sought to establish food miles and greenhouse gas emissions for a typical basket of goods (Gaballa & Abraham 2008). The basket travelled 21,760 kilometres by road, almost the same distance as Australia's coastline, and 70,803 kilometres by all forms of transport.

To reduce the impact of food miles on the environment, the term '100-mile diet' has been coined, which describes a diet that only includes foods sourced within 100 miles (160 kilometres) of a person's place of residence.

Food safety

Food safety is an important consideration for many people. A representative study of Australian adults in 2002 (Williams et al. 2004) reported that common responses to perceived hazards to the safety and quality of food in Australia were additive and chemical residues (28% of respondents), food processing, handling and freshness (21%), food hygiene or contamination (14%) and GM foods (14%). Those in the younger age group (18–24) generally expressed fewer concerns than older adults.

In 2007, FSANZ undertook a survey to identify consumers' attitudes towards, and confidence in, the Australia and New Zealand food supply (FSANZ 2008e). In general, Australian respondents most commonly identified food poisoning (such as *Salmonella* and *E. coli*) and the storage time of food sold (48% of Australian respondents) as areas they were concerned about. However, the highest level of concern by Australians related to cloned animals in the food supply, GM foods and food safety/hygiene. The report noted that these results were likely to be influenced by media reports around the time of the survey.





5.5 Information and marketing

Food labels, advertising, food and nutrition information and the food environment all contribute to food selections made by consumers. Groups exerting influence include the food industry, government organisations, non-government organisations, consumer groups and health professionals.

Food labelling

A range of nutritional and other information is attached to food products to help consumers make safe and healthy food choices. Some labelling is mandatory, while other information is included voluntarily by manufacturers. Information requirements on food labels are regulated by FSANZ and outlined in the Australia New Zealand Food Standards Code (the Code) (FSANZ 2012b). Some foods are exempt from labelling, for example, foods that are packaged at the point of sale or foods in very small packages.

Overall, labelling must be in English, legible and prominent. It must also be truthful, for example, providing accurate weights and measures and including an accurate description of the product. In addition, packaged food must provide a list of ingredients and food additives, including any potential allergens, a nutrition information panel that outlines the level of key nutrients in the product, date marking, country of origin data and contact details for the manufacturer or importer.

Use of food labels

Consumers use food labels for a range of reasons—to reduce intake of saturated fat, salt or sugar for health reasons, to avoid a particular ingredient or food additive that may cause an allergy or intolerance, or to avoid foods for personal reasons, such as eggs from caged chickens.

In a consumer attitude survey published by FSANZ (2008e), one-third of respondents reported that they referred to food labelling information when buying a product for the first time. The main reasons for referring to the labels were for general health concerns (64%), weight management (50%), specific health concerns (for example, diabetes or high blood pressure) (42%) and food allergies (23%). The main information sought was the best-before or use-by date (73%), fat content (62%), country of origin (59%), sugar content (57%), the ingredient list in general (53%) and saturated fat content (50%).

Nutrition, health and related claims

Nutrition content, health and related claims are voluntary statements made by manufacturers on labels and in advertising about the nutrient content of a food, or a relationship between a food and health (FSANZ 2012f).

Nutrition content claims are claims such as 'low fat', 'source of calcium' or 'light/lite'. Health claims refer to a relationship between a food and health, such as 'rich in calcium for strong bones'. Related claims include nutrition or health-related endorsements, that are not regulated under the Code.

As part of the development of the draft standard for nutrition, health and related claims, FSANZ commissioned research to determine consumer understanding of nutrient content claims, and consumer understanding and use of percentage daily intakes and percentage recommended dietary intake in the nutrition information panel in purchasing decisions (TNS Social Research 2007). These studies found that participants were confused about the terms 'dietary' and 'daily' and used them interchangeably. However, front-of-pack labelling using percentage daily intake (% DI) values for all nutrients in the nutrition information panel was valued by consumers.





In a recent Australian study, Kelly and colleagues (2009) questioned the benefits of nutrition content claims because of the ability of manufacturers to promote single nutritional attributes that may make the product appear to be a healthy choice, when in fact this desirable attribute was offset by less favourable characteristics. In their study on the extent to which nutrition content claims were used to market 'unhealthy' food, researchers found that more than 1 in 5 (22%) of all food advertisements made a nutrition content claim and, of these, more than half (55%) were for discretionary foods.

Two further studies commissioned by FSANZ investigated the impact of content claims on foods of lower nutritional value. A survey of Australian and New Zealand consumers found that the presence of a nutrition claim on a label had little influence on their purchasing intent or their assessment of the nutritional value of the product (Roy Morgan Research 2008). Consumers used other label information, such as the nutrition information panel, to evaluate these products before purchasing.

A second in-store survey of grocery shoppers found that 20% of respondents reported reading the nutrition content claim on the label. On-pack information most often read was brand/product/flavour, name, ingredient list and the nutrition information panel (Colmar Brunton Social Research 2007).

FSANZ has been working on a draft Standard for Nutrition, Health and Related Claims which, when gazetted, would be included in the Code. Under the draft Standard, foods would be required to meet certain criteria to be eligible to carry health claims, and it is proposed that all claims would have to be scientifically substantiated and not misleading. The draft Standard still needs to be agreed to by the Legislative and Governance Forum on Food Regulation (the Forum) before it can be incorporated into the Code.

Country of origin labelling

Under the Australian Food Standard Code, packaged (and some unpackaged) food must carry a label, or have a sign nearby, that states the country of origin to help consumers make an informed choice. Unpackaged foods that require country of origin labelling include fresh and processed fruit, vegetables, nuts, fish, fresh pork and preserved pork products such as bacon and ham. This applies to both imported and locally-produced food (ACCC 2011).

Country of origin labelling was considered in the Review of Food Labelling Law and Policy (the Blewett Review) (see Chapter 3). In December 2011, in its response to the Blewett Review, the Forum asked FSANZ to continue its existing process to extend Australia's country of origin labelling requirements to unpackaged beef, veal, lamb, hogget, mutton and chicken and to develop a further proposal to extend country of origin labelling to all other primary food products.

Australian Made, Australian Grown logos

In 1986, the Australian Made, Australian Grown logo was introduced to identify authentic Australian products. Since then, four additional descriptors approved for use with the logo have been introduced, making five categories to help identify Australian products or produce: Australian Made, Australian Grown, Product of Australia, Australian Seafood and Australian (to identify Australian products in export markets).

The logo is a registered certification trademark and can only be used on products that are registered with the not-for-profit organisation Australian Made, Australian Grown (AMAG), providing they meet the rules under Australian Consumer Law, as well as those set out in AMAG's more stringent Code of Practice. Selected AMAG categories are in Box 5.2





Box 5.2 Selected Australian made, Australian grown logo categories

Australian Made: The product was substantially transformed in Australia and at least 50% of the cost of production was incurred in Australia.

Product of Australia: All of the product's significant ingredients came from Australia, and all (or virtually all) of the manufacturing or processing occurred in Australia.

Australian Grown: Each significant ingredient was grown in Australia, and all (or virtually all) of its production occurred in Australia.



The AMAG logo is recognised by most consumers (about 95%). Further, 85% trust the logo over any other country of origin branding such as flags, maps and pictures of animals, and 65% consciously buy Australian Made or Australian Grown whenever possible (Roy Morgan Research 2009b). However, consumer purchasing behaviour is also influenced by price and quality, with just over half (53%) claiming they would buy an imported product over a similar Australian-made brand if it were cheaper, and just under a third (36%) if it were a better quality product.

Point-of-sale information for quick service restaurants

Foods prepared outside the home tend to be high in energy, saturated fat, sugar and salt (Burns et al. 2002). To help reduce the intake of less healthy food components, the Food Regulation Standing Committee prepared the Principles for Introducing Point-of-Sale Nutrition Information at Standard Food Outlets in consultation with AHMAC (Food Regulation Standing Committee 2011). These principles will support the development of a nationally consistent approach to the provision of point-of-sale information in standardised quick service restaurants. The New South Wales, South Australian and Australian Capital Territory governments currently, or plan to, require food retailers to display kilojoule information at point of sale. A number of quick service restaurants have implemented these schemes voluntarily.

Food advertising

Advertising is widely used by companies to attract public attention to a product and encourage its consumption or purchase. Depending on the type of product and target audience, this may involve television, print or radio advertisements, sponsorship, product placement or sales promotions. Television is the most popular means of promoting food and beverage products worldwide (WHO 2004a). It has also been subject to the most debate, particularly regarding children—a population group who may be less able to distinguish advertising from objective information.

Responding to concerns over diet-related diseases such as heart disease, certain types of cancer, diabetes and obesity, health advocates have argued that advertisements contribute to poor food choices and potentially weight gain (Australian Centre for Health Promotion 2006). In response, some countries have implemented voluntary or mandatory restrictions on advertising based on certain food types, target groups and the timing of exposure. In its 2004 Global Strategy on Diet, Physical Activity and Health report, the WHO has also called for advertising messages that encourage healthy dietary practices and physical activity (WHO 2004b).





Advertising to children

Television advertising influences children's food preferences, purchase requests and consumption patterns (National Preventative Health Taskforce 2009c). Food advertising to children is increasing worldwide and most is for foods with a high content of fat, sugar or salt (WHO 2010). Australian children's exposure to television food advertising is among the highest in the world (Wake et al. 2003). Australian children who watch 20 hours of television or more per week (almost 3 hours per day) are twice as likely to be overweight or obese as children who watch less (Wake et al. 2003; Institute of Medicine 2005). High-fat/high-sugar food advertisements on Australian television are more frequent during children's compared with adults' viewing hours; and during popular children's programs (Kelly et al. 2007).

Television food advertising is increasingly being integrated with a wide range of communication techniques that focus on branding and building relationships with consumers, including sponsorship, product placement, use of celebrities, brand mascots, web sites, point-of-purchase displays, emails and text messages (National Preventative Health Taskforce 2009c).

The Australian Communications and Media Authority (ACMA) revised the Children's Television Standards in 2009, but there was no restriction on the advertising of food and beverages during children's viewing times. Reasons for this included limited evidence on the benefits of banning food advertising and a questionable link between television viewing and weight. However, the ACMA has indicated it would be willing to review the Standard if the evidence for the effectiveness of restricting food advertising becomes stronger and an Australian standard for food identification is available (National Preventative Health Taskforce 2009c).

In 2009, it was estimated that 79% of children aged 5–14 accessed the Internet either at school or home, with nearly all children aged 12–14 (96%) having accessed the Internet (ABS 2009d). In a study on Internet food marketing, Kelly and colleagues (2008a) found that of all popular children's websites, nearly half (44%) contained food references. Of these, 11% directly targeted young children and 3% targeted adolescents. There were 932 food references on the websites, with significantly more references for unhealthy food than healthy food categories (Kelly et al. 2008b).

There are no regulations in Australia relating to Internet advertising, but advertisers are subject to the voluntary Food and Beverages Advertising and Marketing Code developed by the Australian Association of National Advertisers (AANA 2009). This Code only covers paid advertisements and does not apply to advertising on a company's own website.

After the WHO recommendation on the marketing of foods and non-alcoholic beverages to children as part of the Global Strategy for the Prevention and Control of Non-communicable Diseases (WHO 2008a), a number of countries are developing policies and principles to implement these recommendations.

Government action

Various levels of government have taken action on regulating food and beverage advertising to children, with the specific aim of tackling the growing prevalence of people who are overweight or obese.

In 2009, the final report of the National Preventative Health Taskforce recommended 10 key action areas, one of which was to 'reduce exposure of children and others to the marketing, advertising, promotion and sponsorship of energy-dense nutrient-poor foods and beverages' (National Preventative Health Taskforce 2009a).

Subsequent to the work of the Taskforce, the Australian National Preventive Health Agency (ANPHA) was established in 2011.





In May 2012, the ANPHA and South Australian Department of Health co-hosted a national seminar on food advertising and marketing to children to discuss actions to reduce children's exposure to marketing of unhealthy food and beverages. Outcomes included formation of a working group of government and industry stakeholders to review existing codes and initiatives, and provide advice and develop a monitoring framework to facilitate consistent and comparable data collection (Australian National Preventive Health Agency & SA Health 2012).

Industry action

The food industry has established two voluntary initiatives administered by the AFGC that aim to reduce the exposure of children to the advertising of food high in sugar, salt and/or fat:

- the Responsible Children's Marketing Initiative, effective from 1 January 2009
- Australian Quick Service Restaurant Industry Initiative for Responsible Advertising and Marketing to Children, effective from 1 August 2009.

To date, 17 food manufacturers have signed the Responsible Children's Marketing Initiative and committed not to advertise to children under the age of 12, unless they promote nutritious dietary choices and a healthy lifestyle (AFGC 2008).

In the United States, the Walt Disney Company announced in June 2012 that starting in 2015, all food advertising on their television and radio channels and Internet destinations (aimed at families with younger children) will be required to meet their nutrition criteria for energy, saturated fat, sodium and sugar (The Walt Disney Company 2012). A number of children's Disney channels are available in Australia through pay television.

Food and nutrition information

Sound nutrition knowledge is important to enable healthy food choices. Hendrie and colleagues (2008) investigated the extent of nutrition knowledge and the demographic variation in a non-representative sample of South Australian residents. They found that messages on key Australian Dietary Guidelines are reaching the community; however, knowledge on converting this to food choice is poor, for example, people eating the recommended serves of fruit and vegetables. The study found that nutrition knowledge increased with age and was higher among women, those who had a tertiary degree, people who were employed, and individuals from areas of higher socioeconomic status.

There are a number of avenues in Australia for consumers to obtain information relating to food and nutrition, much of which focuses on healthy eating and physical activity to help prevent or reduce the increasing prevalence of people who are overweight or obese and other lifestyle-related chronic diseases.

Australian Government

The Australian Government develops nutrition recommendations for Australians and provides a range of supporting material. The Australian Dietary Guidelines provide guidance on the food groups and lifestyle patterns that promote good nutrition and health (NHMRC 2003a, 2003b). The *Australian guide to healthy eating* specifies quantitative recommendations for food intake, based on the Australian Dietary Guidelines (Smith et al. 1998).

The Healthy Weight website includes healthy eating tips and information on physical activity and nutrition to help Australians achieve and maintain a healthy weight:

<www.healthyactive.gov.au/internet/healthyactive/Publishing.nsf/Content/healthyweight>.





Measure Up campaign

The *Measure Up* campaign, launched in October 2008, aims to raise awareness of the health impacts of excess abdominal fat and the benefits of healthy lifestyle choices. The campaign website provides useful and practical information to support people to make healthier dietary choices, and includes tips for shopping and ideas for healthy snacking and meals: <www.measureup.gov.au>.

Swap It, Don't Stop It campaign

The second phase of the Measure Up campaign is *Swap It, Don't Stop It*, that builds on phase 1 and shows people how they can make small lifestyle changes to improve their health.

Get Set 4 Life

The *Get Set 4 Life—Habits for Healthy Kids* is an interactive guide that provides practical information for parents on key areas of health and development including healthy eating and regular exercise (Australian Government Department of Health and Ageing & CSIRO 2008). It is part of the Healthy Kids Check, which aims to ensure every 4 year old in Australia has a basic health check to see if they are healthy, fit and ready to learn when they start school. For more information on the *Get Set 4 Life* guide and the Healthy Kids Check see: <www.health.gov.au/epc>.

Go for 2&5™

The national *Go for 2&5™* campaign was launched in April 2005 to provide families with reliable, practical and consumer friendly information on the importance of healthy eating and physical activity to maintain a healthier lifestyle. Each state and territory government has implemented its own promotion based on the campaign. Components of the campaigns include TV and radio commercials, publications, event sponsorship and point-of-sale information.

An evaluation of the national campaign undertaken by two telephone surveys in 2005 sought to target parents and carers of children and youth (aged 0–17), with a secondary target audience of children aged 5–12 and youth aged 13–17 (Woolcott Research 2007). The evaluation showed that the campaign had generated awareness, both among parents of 0 to 17 year olds, and 9 to 12 year old children. It had also increased knowledge—particularly in the area of the recommended consumption level of vegetables.

These improvements translated to a significant decrease in low-level vegetable consumption (one serve) and a corresponding increase in mid-level consumption (four serves) among parents. However, these changes did not result in a significant increase in the proportion of parents who ate the recommended five or more serves of vegetables per day between surveys.

The evaluation noted that the base of awareness and knowledge that was built by the national campaign (on top of an already successful campaign in Western Australia) may generate behavioural change in the longer term.

Food Standards Australia New Zealand

FSANZ develops fact sheets and brochures on food and nutrition issues, which are available on the FSANZ website: <www.foodstandards.gov.au>. Various web videos are also available in a range of languages.





State and territory governments

The state and territory health departments also play an active role in providing nutrition information to consumers. They often use material developed by the Australian Government as the basis of their work, such as the Australian Dietary Guidelines and the *Australian guide to healthy eating*. Tips for healthy eating and being physically active can be found on their websites:

- New South Wales Health <www.healthykids.nsw.gov.au> and <www.gethealthynsw.com.au>
- The Victorian Government <www.betterhealth.vic.gov.au>
- Queensland Health <www.your30.qld.gov.au>.

State and territory governments are also funded under the National Partnership Agreement on Preventive Health to address the rising prevalence of lifestyle-related chronic disease in settings such as communities, early childhood education and care environments, schools and workplaces. The agreement and related initiatives are discussed in Chapter 3.

Professional and non-government nutrition organisations

Dietitians and nutritionists play an integral role in promoting healthy eating messages. The Dietitians Association of Australia (DAA) is self-regulated and is the peak nutrition body in Australia representing member dietitians and nutritionists. Because there are no rules that govern the use of the terms 'dietitian' or 'nutritionist', DAA's accreditation programs for dietitians and nutritionists offer a means of distinguishing individuals who have received an approved level of training and experience.

Accredited Practising Dietitians have university qualifications and accreditation by DAA to provide expert individual nutrition advice or medical nutrition therapy on a range of health conditions. They work in a variety of settings including hospitals, community health centres, government organisations, private practice, the food industry and research. They are trained to assess an individual's diet in order to manage a wide range of conditions including diabetes, heart disease, cancers, gastrointestinal diseases, food allergies, food intolerances as well as overweight and obesity.

Accredited nutritionists are tertiary qualified nutrition professionals who have met the DAA accreditation requirements and have expertise in a range of nutrition services including public health nutrition, community health and tertiary education related to nutrition, but excluding individual dietary counseling, group therapy and medical nutrition therapy. Further information on the training and accreditation of dietitians and nutritionists is available in Section 3.4.

The Nutrition Society of Australia (NSA) offers scientific support and a registration program for professionals in the nutrition field. There are about 150 NSA members on its register of nutritionists.

Other health professionals

Many health professionals deal with health problems that have a nutritional component and in many instances they are the first point of contact for providing nutrition advice. Among these professionals are GPs, nurses, community health workers, health educators, physiotherapists, podiatrists, social workers and pharmacists.

The medical profession can be an important avenue for nutrition education. The Australian Government Department of Health and Ageing has produced resources known as Lifescripts, that give GPs the tools and skills to help patients address the main lifestyle risk factors for chronic disease, such as poor nutrition, physical inactivity and unhealthy weight. Lifescripts that cover appropriate nutrition during pregnancy are also available.





GPs are particularly suited to identifying individuals who require particular nutritional attention and undertake counselling and/or disseminate nutrition information (Nicholas et al. 2005). In their study on GPs in New South Wales, Nicholas and colleagues (2005) found that while more than two-thirds (66%) of respondents agreed or strongly agreed that they had the knowledge to provide nutrition counselling, they were slightly less likely to agree that they had the skills, confidence and experience to provide it (between 56% and 64%). Almost all GPs (98%) reported that they provided some nutrition counselling, with 85% providing nutrition leaflets.

Media

Stories about food and nutrition are in the media almost daily, but information can sometimes be confusing and contradictory. It may be difficult for consumers to decide whether there is a firm scientific basis to the information presented in newspaper articles, popular magazines, medical advice columns, cooking or lifestyle features and on radio, television and the Internet. Celebrity cooking shows and programs such as *MasterChef* attract a large following, especially amongst young people and inspire an interest in learning how to prepare and enjoy food. Weight loss programs such as *The Biggest Loser* and accompanying websites inspire viewers and offer tips on developing healthier eating and exercise habits.

Government social marketing campaigns have the potential to reach a wide audience to promote healthy eating and the importance of being physically active; for example, *Measure Up* and *Swap It, Don't Stop It*.

Some mobile phone applications are available to help consumers compare prices and the 'healthiness' of products, and to choose a healthier option where available.

5.6 Food preparation settings

Availability and choice of food can be influenced, and limited, by when and where it is prepared and by whom. Australians eat their meals in a variety of settings—in the home, at commercial food outlets and in institutional settings such as child care centres, schools, the workplace, hospitals, aged care facilities, prisons and military establishments. The setting chosen can be for pleasure (for example, eating at a restaurant), convenience (for example, a workplace canteen) or out of necessity (for example, food services in hospitals).

Home cooked

As discussed previously, eating habits develop from birth and are influenced by family, friends and the environment. A recent study by Chen and colleagues (2012) suggested that more frequent home cooking by the elderly may be a factor in increased longevity. Further, family meal patterns (such as eating meals together) can have a substantial impact on the nutritional quality of children's diets. Three American studies that examined the association between eating dinners as a family and diet quality, found those who had more frequent family dinners had a healthier dietary intake pattern (Gillman et al. 2000; Neumark-Sztainer et al. 2003; Cason 2006). In addition to nutritional benefits, meals in the company of others can facilitate interaction, communication and a sense of unity (Cason 2006).





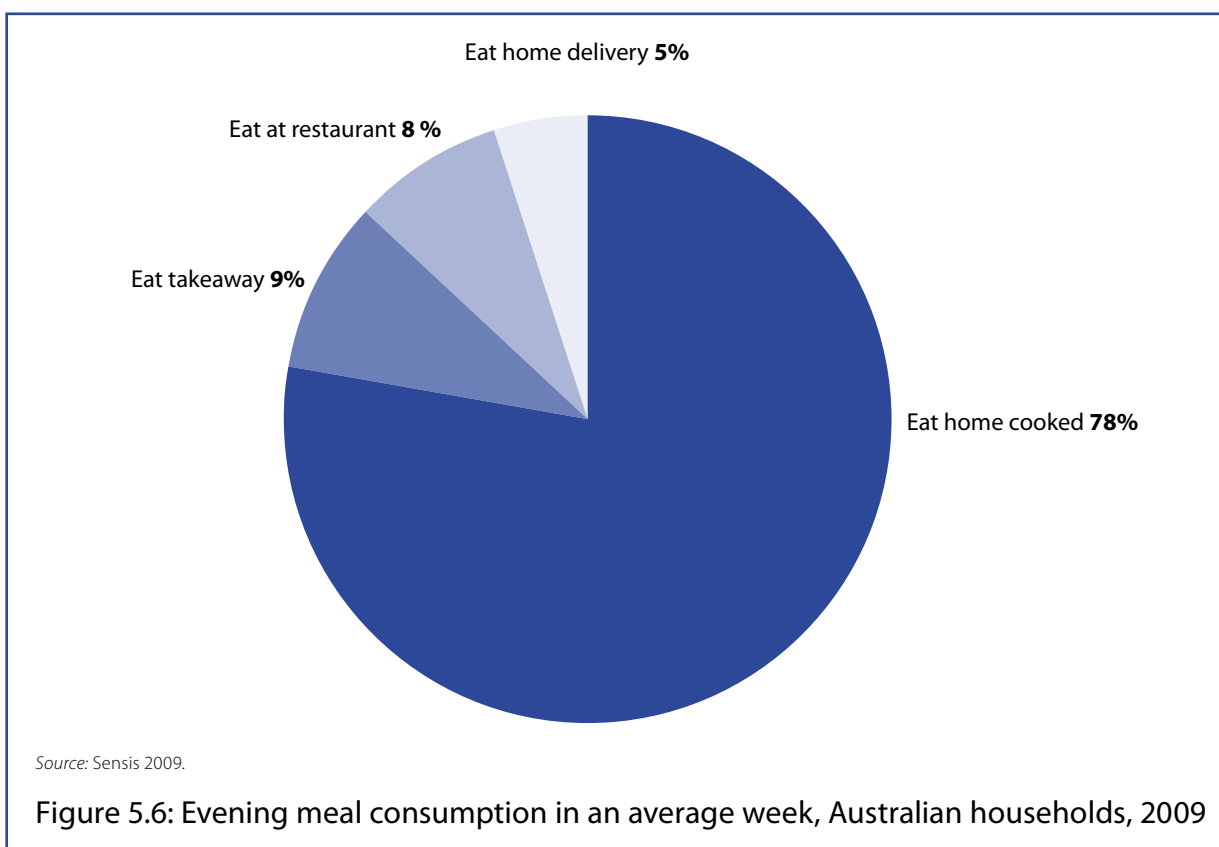
Takeaway food

Takeaway includes foods or meals prepared and purchased outside the home that are ready for immediate consumption (Turrell & Giskes 2007). This encompasses an array of stores selling many different food types—for example, coffee shops, cafeterias, sandwich bars and restaurants.

It has been suggested that the prevalence of takeaway food, particularly fast food, is a contributing factor to rising rates of people who are overweight or obese in Australia and other developed countries. Some researchers and commentators have suggested that socioeconomic differences in the consumption of fast foods may be a reason for higher levels of obesity among individuals of lower socioeconomic status and the most disadvantaged areas (Burns & Inglis 2007).

What type of meals do Australians have for dinner?

Despite growth in the food retailing industry, home-cooked meals are the most popular (Sensis 2009). In 2009, Australians reported eating a home-cooked meal almost 4 out of 5 evenings (79%) (Figure 5.6). Takeaway was the next most popular option, accounting for 9% of evening meals, closely followed by eating in a restaurant (8%). The least popular option was home delivery (5%). Females were more likely to report that they prepared their evening meal themselves. Males were more likely to report eating at restaurants, eating takeaway or home delivered food.





Institutional settings

In addition to home and restaurants, food is also prepared and eaten in institutional settings. In these settings, the clientele may depend on the institution to provide a large proportion, or even all, of the food they consume and as such, the nutritional value is critical. In some circumstances, the clients may be at higher nutritional risk than the general population (for example, in aged care facilities); therefore, the nutritional content needs more careful consideration than in a commercial restaurant or café (Williams 2009).

Nutrition guidelines for many of these settings are under the control of jurisdictions (for example, the Queensland Corrective Services Food and Nutrition Policy and Implementation Plan (2009) and the New South Wales Health Nutrition Care Policy (2011)), with national accreditation standards also playing a role in some cases, for example, the Australian Council of Healthcare Standards healthcare accreditation programs (ACHS 2012), although with limited nutritional specifications. Standard 3.3.1—Food Safety Programs for Food Service to Vulnerable Persons of the Code also applies to settings such as hospitals, aged care and child care facilities (FSANZ 2008h).

While guidelines and standards may specify adequate nutritional meal requirements, people may not always eat the food provided. Studies have shown malnutrition can occur in these settings—particularly aged care—and monitoring is required in addition to the supply of adequate nutritional meals (Gaskill et al. 2008).

Institutional settings can provide useful opportunities to implement public health initiatives. There is a trend in many Western countries, where the prevalence of overweight and obese children is of concern, to impose greater control on the food available for consumption in child care centres and primary and secondary schools. Child care facilities play an important role in developing good eating patterns in young children by providing access to healthy food options in a positive environment, and may influence eating behaviours in the long term (Bravo & Cass 2003). As some children spend long periods in care, the food they receive in this setting makes an important contribution to their overall diet and health.

Schools

Schools are an increasingly important setting for multiple complementary approaches to improving the health of students through supportive environments, nutrition education and curriculum strategies.

Government funding has been provided for a National Healthy School Canteens Project. This project aims to help school canteens provide healthy food choices and, consequently, promote good health through healthy eating to reduce levels of obesity and chronic diseases later in life. The project has three components: a national food categorisation system for school canteens; training materials for canteen staff; and an evaluation framework. This project will build on existing models being implemented by a number of state and territory governments and encourage a nationally consistent approach to promoting healthy food through school canteens.





Food and nutrition education in schools

Nutrition education in schools is fundamental in supporting young people to develop sustainable, health-promoting eating behaviours. Reynolds (2006) provides guidance on maximising teachers' work in nutrition education:

- Teaching students about nutritional recommendations is insufficient to bring about behaviour change—it is important for students to explore their eating habits and the implications on their health. Students should feel empowered to follow a healthy lifestyle because it will make them feel good.
- Teachers must connect with students' worlds—the types of food they eat, the family environment, sporting interests—and explore the topics relevant to them.
- Food preparation classes are integral to teaching about food and nutrition and students should be taught to prepare meals that are cost and time effective, nutritious and tasty. Food preparation should reflect serve size recommendations in the *Australian guide to healthy eating*, including 'extra' foods.

The Home Economics Institute of Australia is the peak professional body for home economics professionals in Australia. Members work in a range of settings, including schools, the community sector and industry, where they focus on food management, nutrition, child care or aged care. Home economics secondary school teachers educate individual students and the school community about food and nutrition.

School curriculum

Each state and territory is responsible for determining how they integrate food and nutrition education and physical activity into the school curriculum. However, Australian education ministers have agreed that national curriculum development work will include a focus on health and physical education, recognising the role that schools can play in shaping healthy lifestyles. In the meantime, state and territory education and training departments have developed jurisdiction-based student health and wellbeing frameworks and programs to help schools develop education programs around health issues.

Stephanie Alexander Kitchen Garden Program

The Stephanie Alexander Kitchen Garden Program provides students in Years 3–6 with opportunities to learn how to grow, harvest, cook and share fresh food in the belief that this approach will provide a better chance of positively influencing their current and future food choices (Australian Government 2012c).

A key feature of the program is the link between the garden, kitchen and table, with the emphasis on learning about food and ways to enjoy different varieties. A second feature is its integration into the curriculum—it is part of the school's program for 4 years of a child's life. See:

<www.healthyactive.gov.au/internet/healthyactive/publishing.nsf/Content/kitchen-garden>.

Wider community

Under the National Partnership Agreement on Preventive Health, the Australian Government is working with the states and territories to address the rising prevalence of lifestyle-related chronic diseases. This includes programs and initiatives that promote healthy eating and exercise behaviours in a range of settings, for example, workplaces and child care centres, and among those with a disability or suffering disadvantage. Social media campaigns complement and support jurisdiction-based programs. Further information about these initiatives is in Chapter 3.





Government agencies have also implemented programs at the state and local levels to build on national initiatives; for example, the VicHealth's *Food for All* program that ensured land use planning decisions, shopping, transport and other local amenities did not affect the ability to access healthy food, and to make healthy food choices on a lifelong basis without resort to community services and/or emergency foods (VicHealth 2008).

It is equally important to monitor and evaluate programs and share resources and outcomes, and work collaboratively to improve community health and wellbeing by supporting equitable and local food chains.



Key points

- Up to 50% of all food produced worldwide is wasted.
- Large amounts of water, energy and resources are wasted when food is not consumed.
- Reducing food waste is an important strategy to increase food availability without requiring additional production resources.
- Food waste affects the environment by interfering with the recycling of nutrients in the biosphere, adding to air pollution when food decays, adding to water pollution from run-off and leaching, and contributing to rapidly expanding landfill.
- There are minimal Australian data to quantify food waste at various stages of the food supply chain.



Food waste

6





Increasing the efficiency of food production is an important strategy to help feed the world's growing population. Reducing food waste is one way to help relieve pressure to increase land use for food production, and it also reduces other related environmental concerns, including water stress, soil degradation and greenhouse gas emissions (UK Government Office for Science 2011).

6.1 Overview

Food waste is not just uneaten food. It occurs throughout the food system, beginning with production, and ending with waste—a 'paddock to plate' approach (Figure 6.1). It can be classified as either unavoidable or avoidable. Inedible portions, such as bone, gristle, fruit and vegetable peelings, are generally considered examples of unavoidable food waste, whereas food discarded because more was produced/purchased than consumed is considered avoidable food waste. In estimating nutritional losses associated with food waste, it is important to distinguish between these two forms.

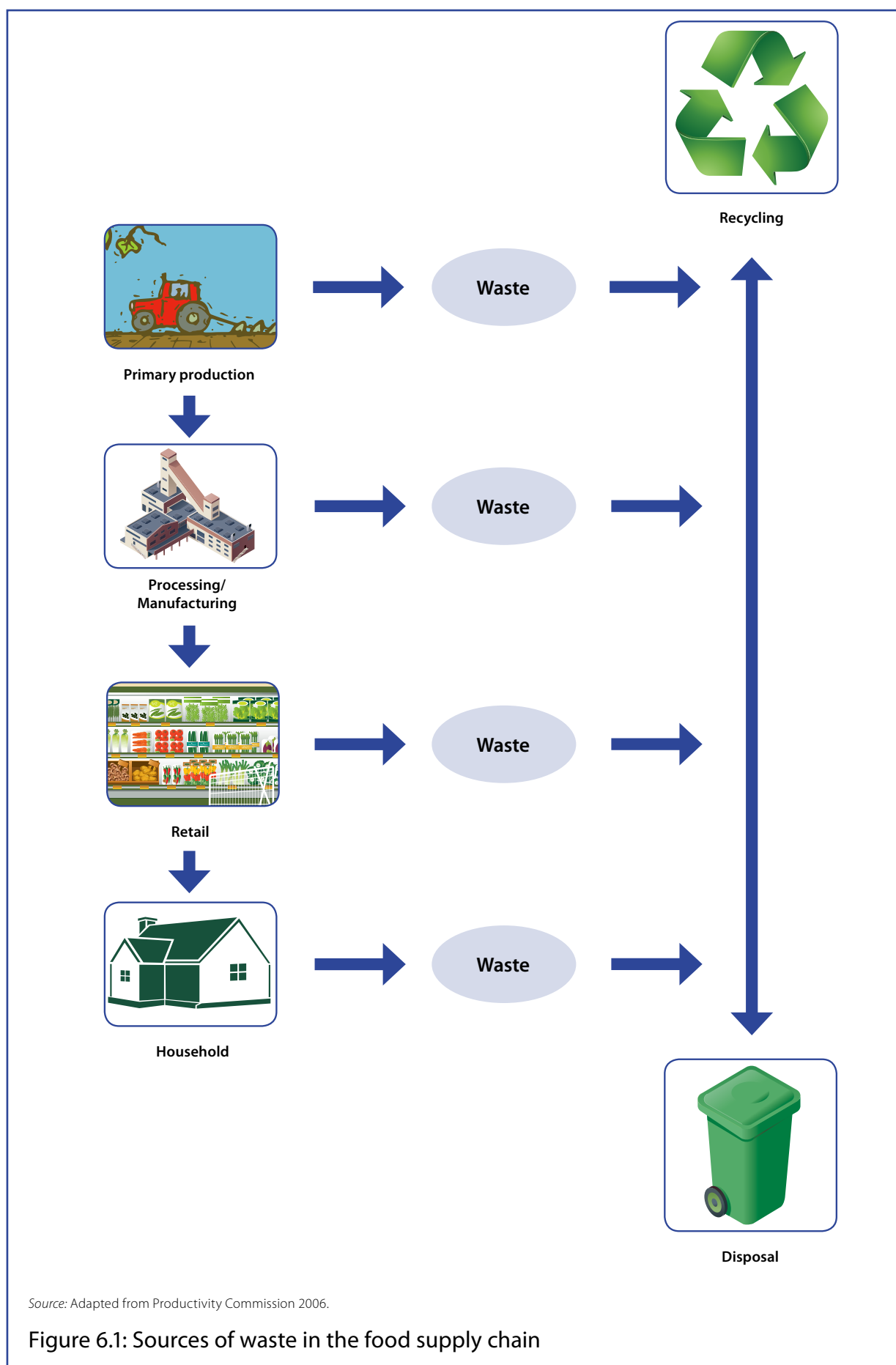
In general, there is a lack of data to quantify the amount of food that is wasted at the various stages of the food supply chain, and estimates vary widely (ABS 2010). A frequently quoted estimate of global food waste is that 'nearly half of all food grown is lost or wasted before and after it reaches the consumer' (Lundqvist et al. 2008). However, the use of a single statistic to quantify waste throughout the food supply system needs to be interpreted with caution.

In measuring food wastage, it is important to capture all the energy and resources used to produce food and not just the final product. For example, to produce 1 kilogram of wheat, between 5 and 400 litres of water are used, contrasted with much higher amounts (5,000 to 20,000 litres) to produce 1 kilogram of meat (Lundqvist et al. 2008).

In developing countries, food wastage is largely due to poorer technologies and infrastructure related to agricultural production, harvesting and manufacturing. In more developed countries, most wastage is further along the food supply chain—at the consumer level (Lundqvist et al. 2008). As the wealth of a country increases, the distance between the site of food production and consumption increases. Consumption patterns also change, resulting in a preference for more water-intensive and less durable foods, such as higher proportions of meat and dairy foods, and a switch from staple cereal crops to higher-value crops such as sugar and vegetables. This shift towards less durable, shorter shelf-life foods is associated with greater food waste (Lundqvist et al. 2008; Parfitt et al. 2010).

In the absence of definitive data to quantify food wastage throughout the Australian food supply chain, more qualitative descriptions are provided in this chapter, together with generalisations from research in other developed countries.







6.2 Sources of food waste

A study in the United States measured food waste across the entire food system in one county, including food production, processing, distribution and consumption (Griffin et al. 2009). Of the 9,250 tonnes of food wasted in 1998–1999, production waste accounted for 20%, processing 1%, distribution 19%, and the remaining 60% of waste occurred at the consumer level. Less than one-third (28%) of total food waste was recovered, with 25% going to composting and 3% to food donations. The remaining 72% was sent to landfill. This was equivalent to 37 billion kilojoules of food wasted per year, enough to theoretically feed residents of the county studied for 6 weeks.

In 2000, the United Kingdom Government funded the Waste & Resources Action Programme (WRAP) with the intention to tackle waste issues, including food waste. WRAP estimated that 4.1 million tonnes of avoidable food waste was generated each year in the United Kingdom, with households responsible for the largest portion (53%), followed by the food service sector (26%), the food manufacturing sector (20%) and the retail and distribution sector (< 1%) (WRAP 2009, 2010).

While these specific amounts may not be generalised to Australia, they do show that in developed countries considerable food wastage occurs throughout the supply system, particularly by consumers. Most studies identify perishable items as the main types of foods wasted. Fresh fruit and vegetables are among the highest proportion of wasted food, followed by bakery and dairy products, meat and fish (WRAP 2008; Morgan 2009).

Primary production

Food wastage at the primary production stage is often called ‘post-harvest loss’ and refers to foods lost between harvest and the supply to markets. This can occur as a result of overproduction, pests and disease, fluctuating world markets, inappropriate handling and storage, food spoilage and climatic events.

Losses at farm level are estimated to be 12–30% in the United States, depending on the industry (Jones 2004), with larger proportions of waste associated with highly perishable food items (Parfitt et al. 2010).

A different type of post-harvest loss is the edible portion of food that is discarded on-farm due to a failure to meet quality or cosmetic criteria set by the retailers. Large quantities of food are frequently discarded as they fail to meet standardised requirements for size, colour and shape of produce. It is often difficult to obtain accurate measures for these losses (Stuart 2009). For example, not all food grade bananas are totally wasted as some can be disposed of as animal feed or compost (Horticulture Australia 2010).

The dominance of the large supermarket chains in the Australian food supply system means they can exert strong influences on the specifications and acceptability of produce. The trend in consumer demand for unblemished produce often results in farmers discarding large amounts of edible food before it leaves the farm to avoid it being rejected when it reaches market. White and colleagues (2011) attempted to quantify the environmental, economic and social impacts of fresh produce specifications through their assessment of the Australian banana industry (Box 6.1).





Box 6.1: The cost of perfection in the Australian banana industry

Bananas are Australia's highest selling fruit with average consumption per person estimated to be 13 kilograms a year. This makes them one of the top 10 selling supermarket items. More than 90% of Australia's bananas are grown in Queensland, with the majority (70%) being sold to Coles and Woolworths (White et al. 2011). In recent years, consumers have preferred a higher quality product that is unblemished, large and uniform in shape, and this trend is reflected in product specifications set by the retailers.

It is estimated that 10–30% of all bananas produced are discarded before they leave the farm (Clarke et al. 2008), with the majority of this waste due to the fruit failing to meet the product specifications set by retailers. White and colleagues (2011) estimate that 52,770 tonnes of edible bananas are discarded each year due to cosmetic imperfections. This represents a yearly loss of \$26.7 million and a nutritional loss of 196 billion kilojoules, along with other nutrients.

Embedded in this waste are large amounts of water (16 gigalitres) and non-renewable resources, such as oil (1,407 tonnes), coal (1,064 tonnes), natural gas (1.8 million cubic meters) and phosphate ore (681 tonnes). In addition, the decomposition of this waste has the potential to generate 23,200 tonnes of carbon dioxide equivalents (White et al. 2011).

The discarding of non-target species caught in wild-capture fishing is another form of production waste. These fish, also known as 'by-catch', are often unmarketable, below minimum size or above quota restrictions and are returned to the sea, in most cases dead or badly damaged. Discard rates are estimated to be 9–15% of marine catches (FAO 2011b) with considerable variation between different fisheries, locations and fishing practices (Kelleher 2005).

Manufacturing

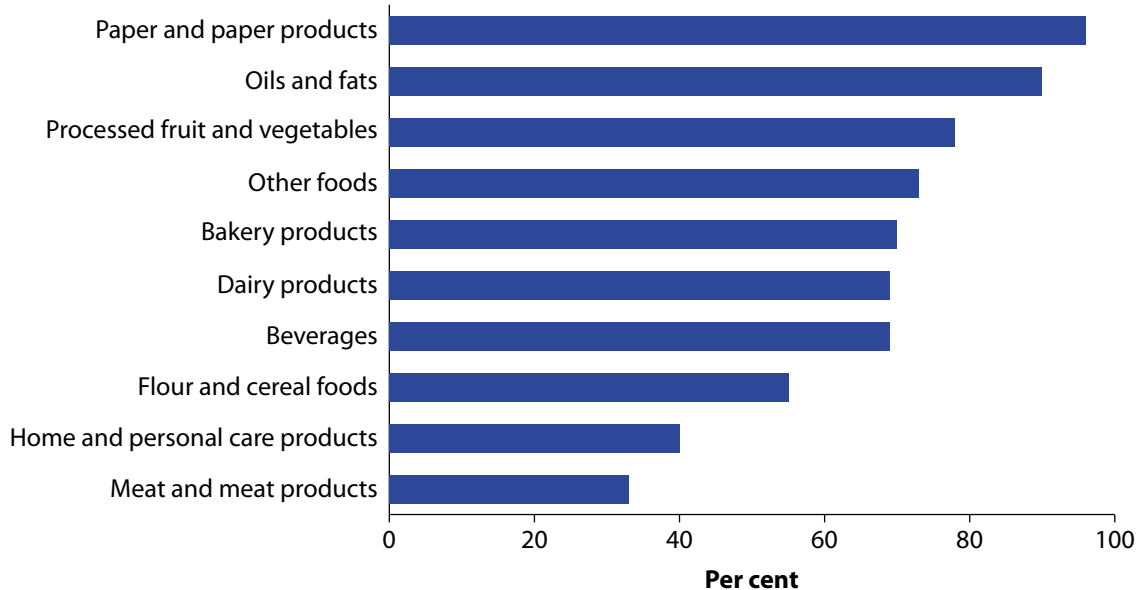
The food and beverage industry is Australia's largest manufacturing industry (DAFF 2012). However, there are limited data on the amount of food wastage occurring in this sector.

It takes large amounts of energy and natural resources to manufacture processed and packaged food. Many businesses are exploring ways to change their manufacturing procedures to decrease waste, energy and water use, as well as ways of re-using waste or by-products.

The AFGC is working to reduce the impact of processed food on the environment. In May 2006, it established a packaging stewardship forum to cover issues such as industry recycling, resource recovery and litter reduction, as well as education initiatives. In February 2008, it established a Sustainable Practices Committee of associated industry representatives to focus on water, waste, energy and social issues (AFGC 2009).

In 2007–08, AFGC members reported recycling 74% of their total waste, which included both food and non-food subsectors, such as home, personal care and paper products. For different subsectors, recycling rates ranged from 33% for meat and meat products to 96% for paper and paper products (AFGC 2009) (Figure 6.2).

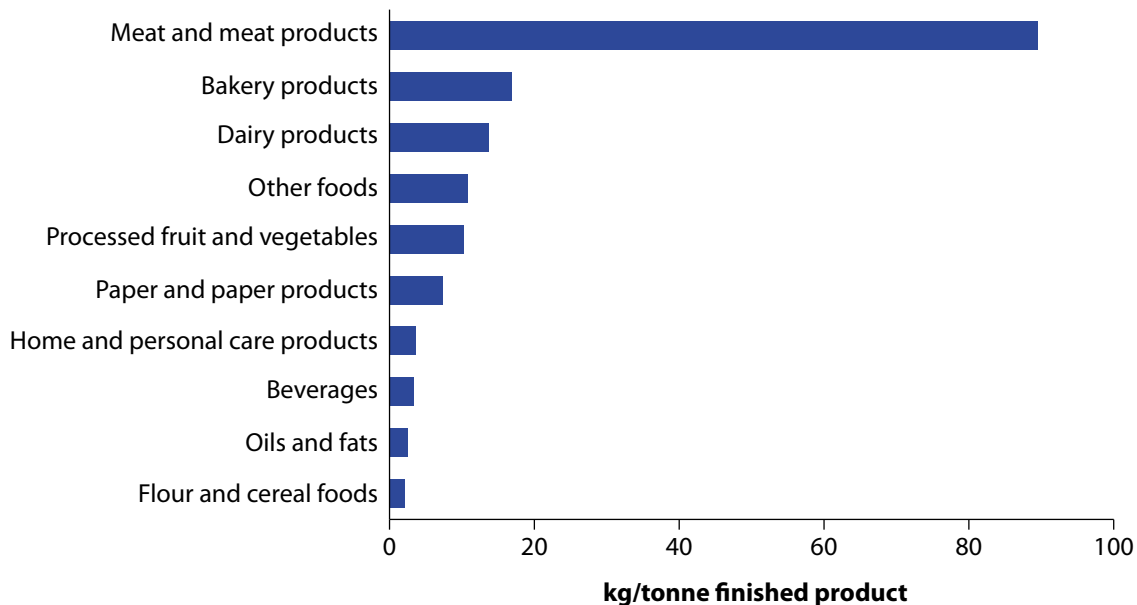




Source: AFGC 2009.

Figure 6.2: Manufacturing subsector recycling rates, 2007–08

In the same survey, AFGC members also reported that there was an average 9 kilograms of production waste per tonne of finished product sent to landfill. This varied between the different subsectors, ranging from 2.06 kilograms per tonne of finished product for the flour and cereal foods subsector to 89.6 kilograms per tonne for the more-perishable meat and meat products (AFGC 2009) (Figure 6.3).



Source: AFGC 2009.

Figure 6.3: Manufacturing subsector waste sent to landfill, 2007–08



Food packaging waste

The relationship between food and packaging waste is complex. While packaging helps to reduce food waste by preventing spoilage and maximising shelf life, the energy and materials in packaging are extensive and much ends up as waste. As such, it is unknown if the environmental costs of processing and packaging are more or less than the environmental costs of wasted food (Larson et al. 2008).

As a result of population increases, demographic change, and a trend towards single-serve packaging, the amount of packaging waste is increasing. Different methods are employed to manage packaging waste, including re-using, recycling, composting, thermal treatment and landfill.

Packaging waste generated from the food system includes:

- Discarded transportation packaging, such as wooden pallets, plastic wrapping and containers. These materials are used to gather packaged goods into larger loads for transport and consignment.
- Discarded secondary packaging, such as larger cases or boxes used to group quantities of primary packaged goods for distribution and display in shops.
- Discarded primary packaging, such as wrapping or containers handled by consumers.

Hyder Consulting (2009) calculated that in Australia in 2005, 4.23 million tonnes of waste were generated from packaging products, including beverage, food and other groceries. These packaging materials consisted of glass, aluminium, plastics, steel cans and paper/cardboard products. Most packaging materials are disposed of immediately and some are recycled; in fact, packaging recovery levels in Australia are one of the highest for any product (56%) (Hyder Consulting 2009).

Retail

Food wastage at the retail level can be due to poor handling techniques, package failures, transportation losses, overstocking, substandard food, and food discarded because it is nearing its use-by date.

As with the sectors mentioned above, there are a lack of statistics on the amount of food wasted in the retail sector. Estimates produced by the United Kingdom Government indicate that after leaving the farm, 13% of food is wasted by supermarkets (Department of Environment Food and Rural Affairs 2007). In the United States, 2005–06 estimates for supermarket wastage of perishable food were 11.6% of fresh fruit, 9.7% of fresh vegetables, and 4.5% of fresh meat, poultry and seafood (Buzby et al. 2009).

Australian supermarkets generate substantial amounts of organic material, mostly from food. While the major supermarket retailers recycle most paper and cardboard waste, the diversion of food waste from landfill is still under development. Various programs initiated include diverting food waste to composting, such as Woolworths partnership with EarthPower (Woolworths 2011), or donating unsold fresh food to charities (see Section 6.5 for further details of various charities).

Food service sector

Food wastage occurring in the food service sector is mainly from food preparation, served but uneaten food, unserved food and spoiled food. Food waste can result when there is ineffective inventory control causing excess, out-of-date and/or obsolete produce, incorrect storage and handling of food items, and inflexible or super-sized menu servings. In the United States, the National Restaurant Association estimates that 20% of all commercially prepared food is wasted (National Restaurant Association 2011).





An audit of Australian caterers' waste bins found that food was the second largest contributor (22%), behind packaging (58%). Along with other matter (14%), around 90% of this waste was found to be potentially recyclable, reusable or compostable (Sustainability Victoria 2005).

Various attempts have been made to assist the food service sector in reducing their food wastage. For example, Sustainability Victoria has developed a Waste Wise Catering Toolkit to educate food service staff on potential sources of waste and to provide strategies on how to develop waste reduction, reuse and recycling action plans (Morgan 2009).

Household

More avoidable food waste is generated in developed countries than in developing countries, in particular at the household level. In Europe and North America, food waste per consumer is estimated to be 95–115 kilograms per year compared with 6–11 kilograms in sub-Saharan and South-East Asia (FAO 2011b).

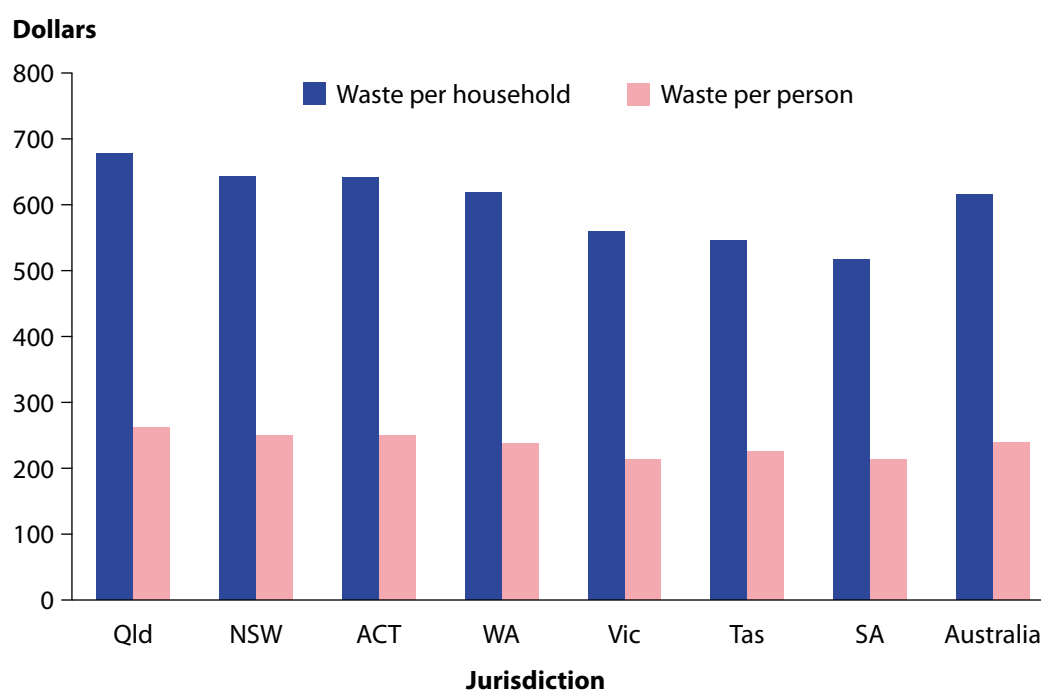
In Australia, households throw out more than \$5 billion worth of food each year. In October 2009, Baker and colleagues (2009) undertook an online Australian survey of 1,603 main grocery buyers that showed:

- Each Australian household threw out an estimated average of \$616 worth of food each year. Queenslanders threw out the most waste per household (\$678) and South Australia the least (\$517) (Figure 6.4).
- The largest food category thrown away was fruit and vegetables (just over \$1.1 billion per year), closely followed by restaurant and takeaway food (about \$1.1 billion per year) and then meat and fish (\$872.5 million per year).
- Households with higher incomes had greater levels of food waste; those with incomes above \$80,000 wasted an average of \$803 worth of food per year compared with \$518 for those with incomes of lower than \$40,000.
- On a per person basis, food wastage increased as household size decreased (Figure 6.5).

By this estimate, the annual amount of food waste by Australian households is greater than the amount (\$3.6 billion) the Australian Government has allocated to duplicate the Pacific Highway in New South Wales by 2016 (Australian Government 2012b).

'In addition to the direct financial costs of this waste, the environmental impact associated with excessive greenhouse gas emissions and water use is substantial.' (Baker et al. 2009:1).

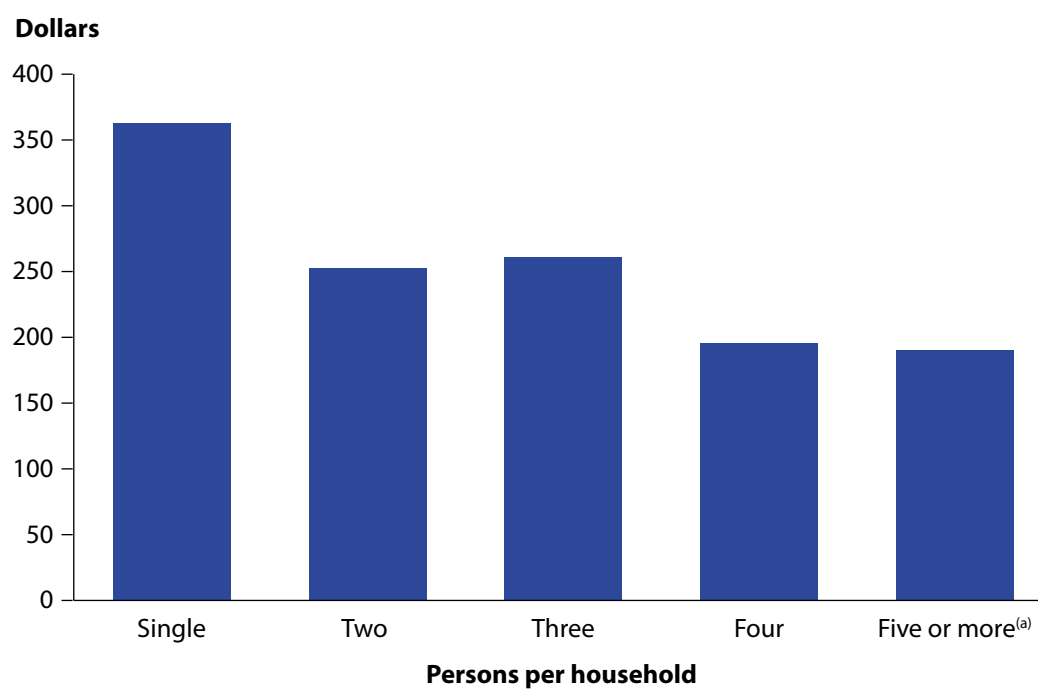




Note: These data are likely to be an underestimate because the survey sought estimates of the amount wasted on dairy products collectively, rather than on milk, yoghurt and cheese separately. Respondents may also have underreported their level of food waste overall.

Source: Baker et al. 2009.

Figure 6.4: Annual food waste in Australia by jurisdiction, 2009



(a) Total average waste divided by six.

Source: Baker et al. 2009.

Figure 6.5: Annual food waste in Australia by household size, 2009





6.3 Waste handling

During 2006–07, about 43.8 million tonnes of waste was generated in Australia, with food waste contributing large amounts to the total waste stream (ABS 2010). Waste generation is a measure of landfill disposal and recycling activity, both of which have increased over the past 20 years. Waste generation is influenced by growth in the economy, increasing population levels, and changing consumption patterns, demographics and household sizes (EPHC 2009).

Landfill

Australia has a strong dependence on landfill for waste disposal and during 2006–07 nearly half (48%) of all waste was sent to landfill. As of 2008, there were at least 665 landfills operating in Australia (EPHC 2009).

About two-thirds (62%) of landfill waste is organic (food, garden, paper, sewage and wood waste), generated mainly from the municipal and commercial/industrial sectors. In 2006–07, Australians generated about 20 million tonnes of organic waste. Of this, only about 6 million tonnes (32%) was recovered (recycled) and the remaining 14 million tonnes were sent to landfill (EPHC 2009). The environmental consequence of organic waste in landfills is discussed in Section 6.5.

Food waste comprises 35% of municipal waste (4.5 million tonnes) and 21% of commercial/industrial waste (3.1 million tonnes). This equates to about 261 kilograms of food waste per person per year, or about 936 kilograms per household per year (DEWHA 2010b).

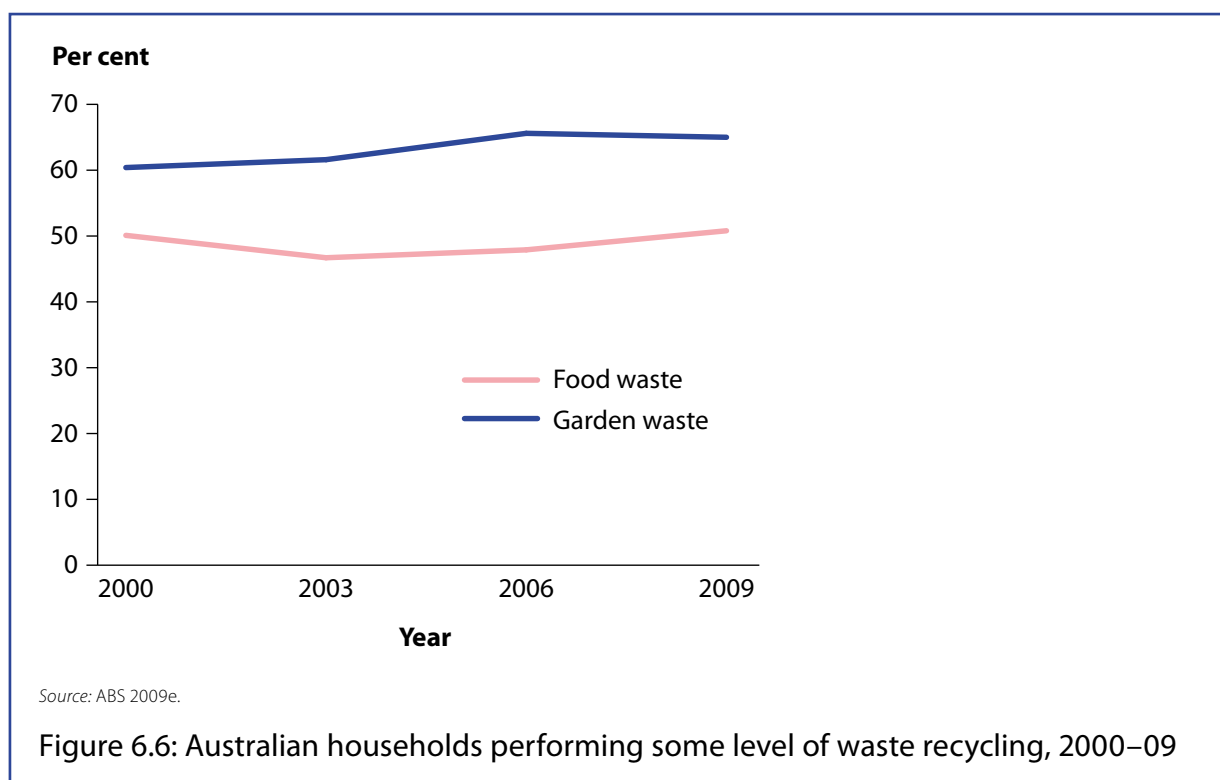
Recycling

Recycling of waste materials reduces the amount of waste sent to landfill and provides a range of environmental benefits, including reducing greenhouse gas emissions, water and energy use.

In 2006–07, about 52% of Australia's waste was recycled. Of this, 22% was from municipal waste, 36% from commercial/industrial waste and 42% from construction and demolition waste (DEWHA 2010b). Due to the amount of food and garden waste, less municipal waste is recycled than the other two waste streams. Unless first sorted at household level, it is difficult to extract food and garden waste at a later stage (DEWHA 2010b).

In 2009, 99% of Australian households engaged in some form of recycling, with 65% recycling garden waste and 51% recycling food waste (ABS 2009e). Since 2000, recycling rates for both garden and food waste has increased slightly (Figure 6.6). However, there is still more that can be done to minimise both garden and food waste being sent to landfill.





6.4 Environmental impacts

Food waste is an environmental and economic concern. Substantial energy losses occur when food is discarded due to the embedded resources required to produce, distribute and store it. In addition, energy and monetary costs are involved in its disposal.

In 2009–10, the ABS estimated that about 52% of total water consumed in Australia was by the agricultural industry (ABS 2011b), and as water waste is a component of food waste, higher food waste affects the efficiency of water used by the agriculture industry. If one-fifth of the food using this water is thrown away, an estimated two million litres of fresh water supplies are being wasted every year.

Food waste also affects the environment by interfering with the recycling of nutrients in the biosphere, adding to air pollution when food decays, adding to water pollution from run-off and leaching, and contributing to rapidly expanding landfill. Therefore, reducing food waste will help decrease the environmental impacts of food production.

Organic waste, including food waste, can be recycled and many jurisdictions have instigated policies and programs to reduce the amount of organic waste sent to landfill. Organic waste can be processed into compost, mulches and soil conditioners. This helps replenish soil carbon levels, lessens water run-off, minimises fertiliser and irrigation needs, and boosts agricultural production (Morgan 2009). See alternative waste treatment technologies in Section 6.5 for further details.

Currently, large-scale composting poses considerable transport costs, making landfill and the importation of synthetic fertilisers more financially attractive. To reverse this trend, transport costs for compost would need to be reduced and financial disincentives for landfill increased (Morgan 2009).





Greenhouse gas emissions

The greater the amount of food waste, the greater the amount of unnecessary greenhouse gas emissions (Baker et al. 2009). This includes indirect emissions that are embodied in food from the various processes involved in its production, transportation, processing and refrigeration, as well as direct emissions from the natural processes associated with the breakdown of the waste.

A by-product of organic waste decomposing in landfill is gas, with about half (55%) being methane. Methane has a global warming potential 21–25 times that of carbon dioxide (IPCC 2001). Therefore, reducing the amount of organic waste going to landfill would help reduce greenhouse gas emissions. Baker and colleagues (2009) estimate that household food waste is responsible for 5.2 Megatonnes of carbon dioxide emissions from landfill, equivalent to the total emissions involved in the manufacture and supply of iron and steel in Australia (CSIRO & University of Sydney 2005, as cited by Baker et al. 2009).

Greenhouse gasses can be captured at landfill sites and used for energy generation. Most major urban landfill sites have this capacity, although many small to medium sized landfills do not. In 2007, 58 landfill gas generation plants were able to capture landfill gas (DEWHA 2010b). In 2005–06, 26% of methane emissions were used to make electricity.

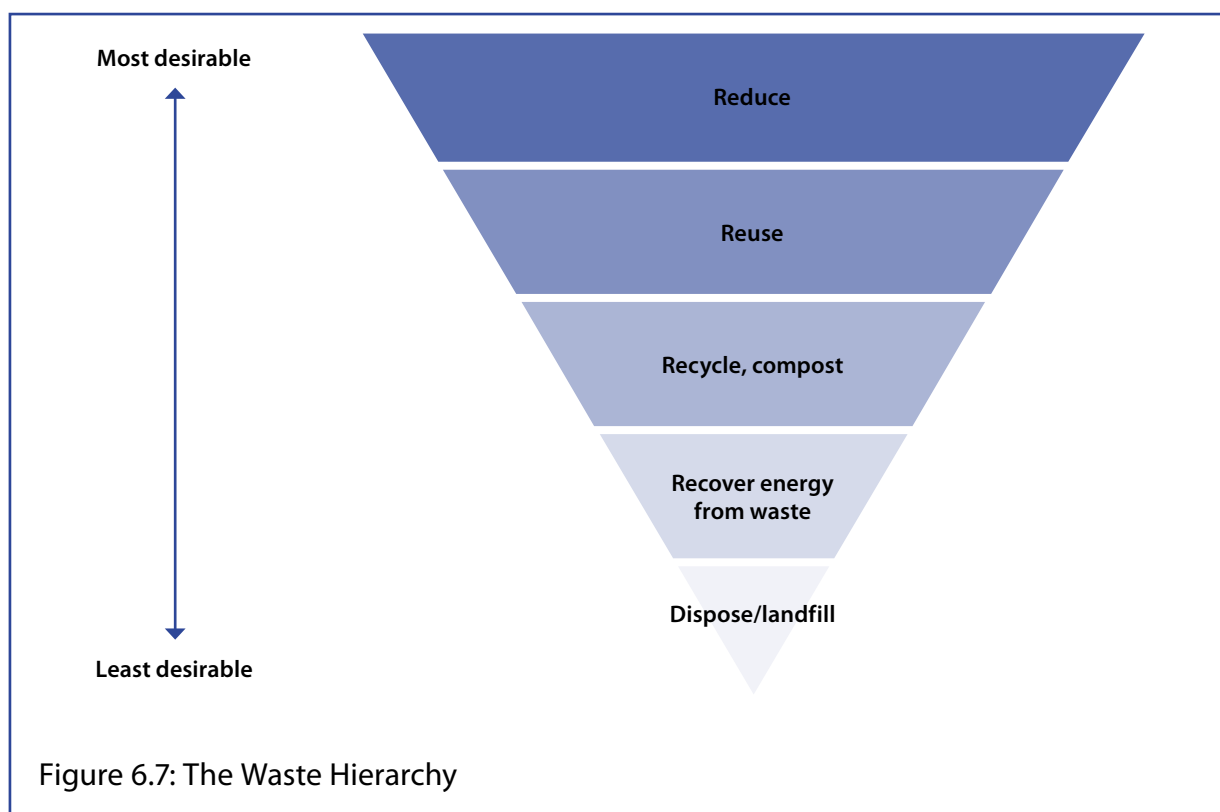
As noted in Section 6.3, composting provides an aerobic alternative for decomposing organic waste, and so is another method for decreasing greenhouse gas emissions.

6.5 Strategies to reduce food waste

To reduce food waste, various strategies need to be employed throughout the whole food supply system. The Waste Hierarchy (Figure 6.7), which has been adopted in the Environmental Protection Acts of most Australian jurisdictions, provides a structured approach to guide programs and policies relating to waste management, with the different approaches arranged in order of preference to encourage best practice. The shortened version of the hierarchy, 'reduce, reuse, recycle' is frequently used in community education campaigns, and is well recognised as a slogan for waste reduction and resource recovery. It promotes waste avoidance ahead of recycling and disposal, and these concepts can be applied to help reduce food waste.

It is becoming increasingly evident that more focus needs to be placed on preventive strategies than waste recycling or recovery. Preventive food waste strategies include encouraging consumers to eat more local produce and seasonally available food, buying only the food that is needed, improving food storage, improving meal planning and cooking skills, and composting food waste where possible. Most current efforts are focused on recycling programs, which although important, are not as effective as prevention or reduction strategies in achieving sustainability (Institute for Sustainable Futures 2005).





Government policies

The management of waste is primarily the responsibility of state and territory governments, with each jurisdiction having its own legislative and policy instruments. In addition, local governments play an important role in providing household waste collection and recycling services, and operating landfill sites.

There has been increasing recognition by governments, industry and the community of the need for a national approach to waste management. In November 2009, Australia's environment ministers endorsed the National Waste Policy: less waste, more resources (Department of the Environment Water Heritage and the Arts 2009). This policy aims to avoid waste generation, reduce the amount of waste for disposal, and manage waste as a resource.

In response, an implementation plan has been devised that provides milestones for reporting on action against the strategies outlined in policy, from 2010 to 2015. The policy also aims to 'help reduce greenhouse emissions, improve energy conservation, raise water efficiency and enhance productivity of the land'. It provides a mechanism for establishing baseline data and for monitoring changes over time.

Education campaigns

Government programs

To reduce food wastage, different jurisdictions have introduced education campaigns that have primarily been aimed at households. For example, the New South Wales Government in May 2010 launched a program called 'Love Food, Hate Waste'. This partnership program, involving households, businesses and local councils, is based on the successful United Kingdom campaign. It provides households with examples of simple and easy behaviours to reduce food wastage, including advice on buying, storing and preparing food to minimise waste (NSW Government and Office of Environment and Heritage 2010).





Social marketing campaigns

FoodWise (Box 6.2) is a national campaign organised by the action group Do something! to raise awareness of the environmental, social and financial impacts of food waste (FoodWise 2009).

Box 6.2: Food Wise aims

- Reduce the 3 million tonnes of food that Australians waste every year.
- Minimise the amount of food that is thrown out by restaurants, manufacturers, retailers and distributors.
- Encourage FoodWise habits—getting people to improve their planning, purchasing, portion control, cooking, storing, freezing and composting of food.
- Maximise public awareness of the environmental impact of Australia's food, particularly regarding food waste and the impact of getting food from 'the paddock to the plate'.
- Improve the measuring and auditing of Australia's food waste, particularly by the Australian Government and state and territory government waste agencies.
- Have national and state food waste reduction targets put in place and monitored by the Australian Government and state and territory governments.
- Maximise the amount of usable food that is donated to food charities.

Source: FoodWise 2009.

Non-government organisations

Organisations such as the Dietitians Association of Australia and the Public Health Association of Australia have developed policy positions and information highlighting the need to minimise waste at all levels of the food chain and providing recommendations for action (DAA 2011; Public Health Association of Australia 2009).

Food rescue agencies

Food rescue agencies play an important role in 'rescuing' unused food that would otherwise end up in landfill. Excess food is distributed to those in need and, in doing so, it is turned into a resource. Each year, agencies such as Foodbank Australia, OzHarvest and SecondBite save thousands of kilograms of food from being sent to landfill.

Foodbank is the largest food relief agency in Australia. More than 700 companies regularly deliver donations to Foodbank warehouses in all states and the Northern Territory. In 2010–11, 24 million kilograms of donated food and groceries were distributed to more than 2,500 charities and community groups across Australia. This made around 32 million meals—or 88,000 meals a day (Foodbank 2012).

OzHarvest operates in Sydney, Canberra, Newcastle and Adelaide. Like Foodbank, it rescues excess food that would otherwise be discarded and distributes it to charities. By 2012, OzHarvest had rescued and delivered more than 10 million meals in Australia (OzHarvest 2012).

SecondBite is a similar organisation that started in Victoria in 2005 and now operates nationally. Since inception, it has distributed 3,400 tonnes of food, which made 6.8 million meals for 350 community food programs (SecondBite 2012).





Alternative waste treatment technologies

New technologies are being developed to convert the increasing amounts of waste into energy or useful by-products. These technologies, termed 'alternative waste treatment technologies', are intended to divert waste from landfill, recover waste from the waste streams and minimise environmental impacts. They are yet to be widely adopted in Australia but offer mechanisms to further reduce or reuse waste in the future. These technologies can be classified into three main types:

- conventional landfill modifications
- biological conversions
- thermal conversions, including incineration, pyrolysis and gasification.

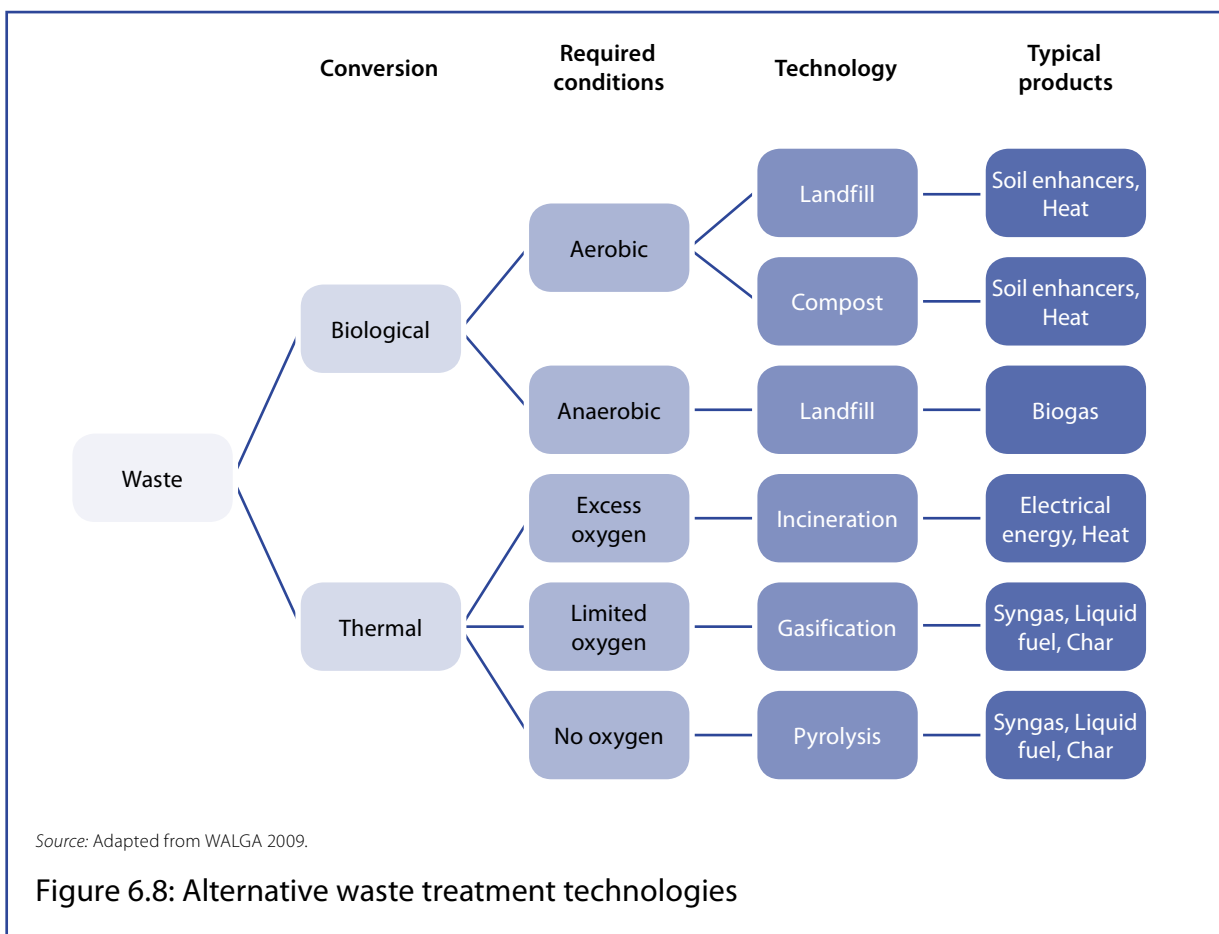
Figure 6.8 provides a schematic representation for two of the alternative waste treatment technologies—biological and thermal conversions.

Conventional landfill modifications

Conventional landfill modifications include both bioreactors and pre-treatment landfills. Bioreactors change the function of landfills from being just a waste depository into a waste treatment site. They operate by speeding up the natural degradation process through the addition of water to enhance the microbial processes that are responsible for the breakdown of the waste and the associated greenhouse gas emissions. Once degradation is complete, the waste is said to be stabilised, a process that can take up to 100 years in a conventional landfills. In contrast, this takes about 10 years with a bioreactor making it more economically feasible to collect biogas (a mixture of methane and carbon dioxide) (Hughes et al. 2011b).

Pre-treatment landfills are those where organic and biodegradable waste products undergo mechanical or biological pre-treatments before being placed in landfill. These treatments result in an overall reduction of waste mass and volume and an improvement in leachate quality (water escaping from landfill). The shredding process increases the surface area of materials and enhances biological processes. The screening process separates plastic and paper from organic materials, aiding the biological treatment of organic waste (WALGA 2009).





Biological conversions

Biological conversions include aerobic decomposition, vermicomposting (using earthworms) and anaerobic digestion.

Aerobic decomposition involves the breakdown of organic matter by micro-organisms in the presence of oxygen to create carbon dioxide, water and heat. This process can be used to convert organic waste into mineral rich soil enhancers to replenish soil nutrients and reduce reliance of inorganic fertilisers. As noted in Section 6.4, composting also increases the water carrying capacity of the soil and plays an important role in carbon sequestration (the capture and long-term storage of carbon dioxide).

Vermicomposting uses earthworms to generate compost instead of micro-organisms. The worms are capable of converting organic materials into high quality soil conditioners, with similar benefits to those described above.

Anaerobic digestion involves the decomposition of organic matter in the absence of oxygen, into methane and smaller amounts of carbon dioxide. This process can be used to decrease the amount of material going to landfill, stabilise organic matter before disposal and recover energy from biogas (a mixture of methane and carbon dioxide) production (WALGA 2009). As with aerobic and vermicomposting systems, the resulting by-product can also be used as an effective soil conditioner.



Thermal technologies

Thermal technologies are processes that use heat to convert waste into stable residues for disposal. Examples of these technologies include incineration, pyrolysis and gasification.

Incineration is a waste treatment process involving the combustion of organic matter in waste materials. Organic compounds are converted into carbon dioxide, water and ash. The benefits of this process include the generation of electrical energy and heating, the reduction of waste volumes by up to 95%, and the sterilisation of hazardous waste components. Despite these benefits, incineration is still an inefficient method of disposal compared with recycling. For example, recycling a plastic bottle saves twice as much energy as burning it in an incinerator (Recycling Revolution 2011).

One problem with incinerating waste is the generation of pollutants. However, more modern incinerators now incorporate pollution mitigation equipment, such as flue gas cleaning, that reduces the environmental impact of this waste treatment process (WALGA 2009).

Like incineration, pyrolysis and gasification are thermal processes that use high temperatures to break down waste but they use less oxygen than incineration. Pyrolysis involves heating organic materials at elevated temperatures in the absence of oxygen. Gasification is a process in which materials are exposed to some oxygen, but not enough to allow combustion to occur. The main product of gasification and pyrolysis is a hydrocarbon-rich gas mixture known as syngas that is composed mainly of carbon monoxide and hydrogen, with smaller quantities of carbon dioxide, nitrogen, methane and other hydrocarbon gases (Wastenet 2006). While the ratios of products vary, most pyrolysis and gasification processes produce a mixture of the following four products:

- gas (often referred to as syngas) for use in energy recovery
- liquid alcohol fuel for use as a feedstock or in energy recovery
- residual char
- solid residue which is either disposed of or refined.

Despite the obvious benefits of these technologies, in terms of waste reduction and the production of useful by-products, the high capital costs associated can be a deterrent to widespread implementation.

6.6 Monitoring and surveillance

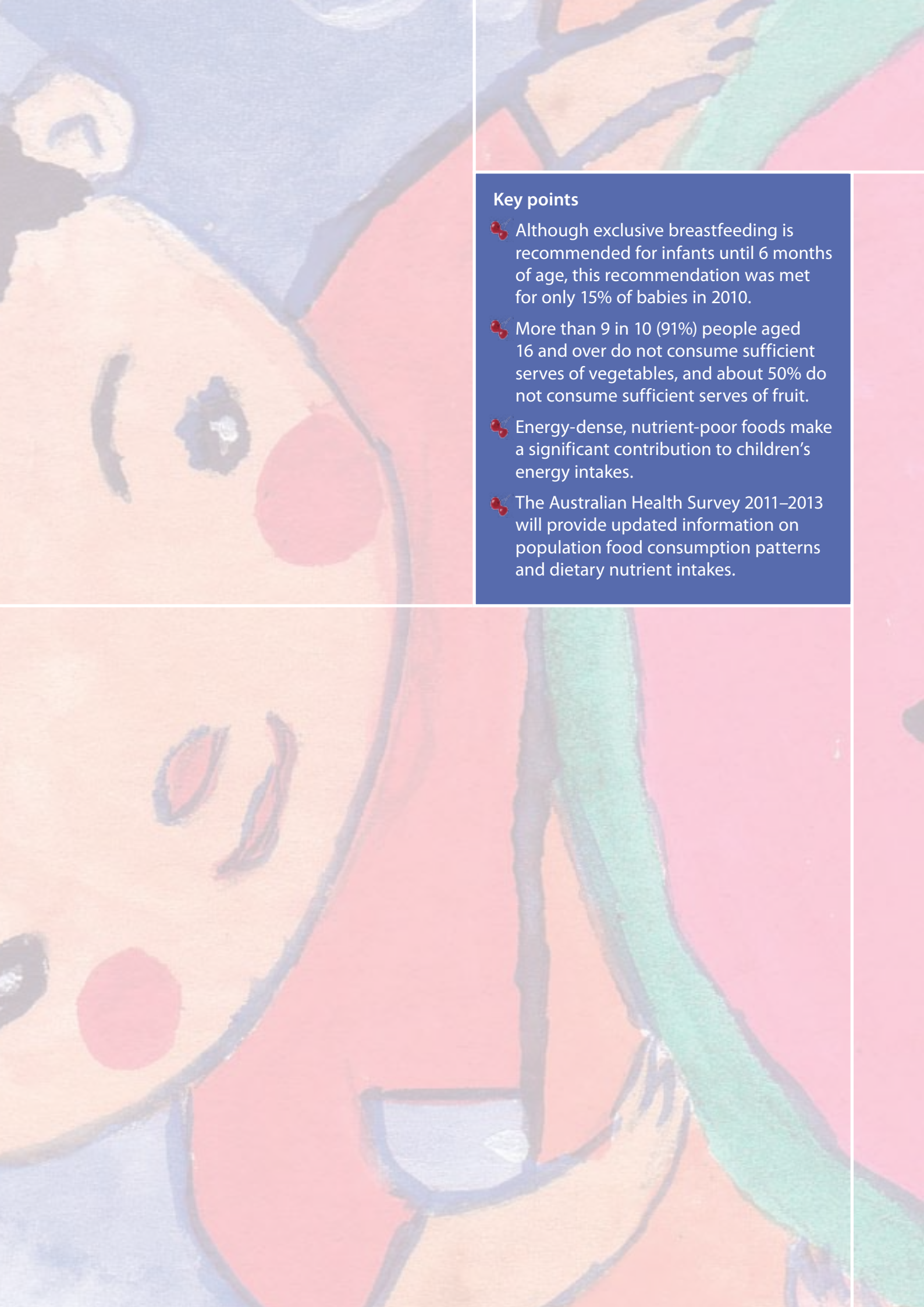
It is generally recognised that decreasing food waste can contribute to the wider policy agenda of improving sustainably and improving world food security, but without reliable food waste data it is unclear where and how much food is being wasted.

There is a need to improve the measuring and auditing of food waste throughout the whole food supply system. Although data on the quantity and variety of general waste is collected by all levels of government for specific regulatory and policy requirements, these data can lack consistency and comparability across jurisdictions and as such do not provide comprehensive, robust national data (EPHC 2009).

This is also true for data relating specifically to food waste. Due to differences in composition and definitions, food waste data are often difficult to measure and spread throughout a number of diverse sources, some of which are commercial-in-confidence.

Regular audits are needed to monitor food wastage in the food supply system and track changes over time. Currently, there are no national targets to provide guidance on food waste reduction efforts, making it difficult to report on progress and achievements. Internationally, halving global food waste by 2050 is considered a realistic target (UK Government Office for Science 2011).





Key points

- Although exclusive breastfeeding is recommended for infants until 6 months of age, this recommendation was met for only 15% of babies in 2010.
- More than 9 in 10 (91%) people aged 16 and over do not consume sufficient serves of vegetables, and about 50% do not consume sufficient serves of fruit.
- Energy-dense, nutrient-poor foods make a significant contribution to children's energy intakes.
- The Australian Health Survey 2011–2013 will provide updated information on population food consumption patterns and dietary nutrient intakes.

Food and nutrient intakes

7





Information on food and nutrient intake and trends is important for policy makers, food regulators, educators and health professionals in their work to promote optimal health and wellbeing.

Most of the food and nutrient data here are from the following national surveys:

- 1995 National Nutrition Survey (NNS)
- 2007 National Children's Nutrition and Physical Activity Survey (Children's survey)
- 2007–08 National Health Survey (NHS)
- 2010 Australian National Infant Feeding Survey (ANIFS)
- 2010 National Drug Strategy Household Survey (NDSHS)

Although the information from the 1995 NNS is now somewhat outdated, it still provides the best available estimate of national food consumption and dietary nutrient intakes for the population aged 16 and over. For children aged 2–16, the 2007 Children's survey provides the most recent national data on food and nutrient intakes. Consequently, this chapter presents data from these two surveys, supplemented by data from the 2007–08 NHS, 2010 ANIFS and the 2010 National Drug Strategy Household Survey. Further details of the methods used to estimate food and nutrient intakes are in Chapter 9.

The Australian Health Survey 2011–2013 will provide updated information on population food consumption patterns and dietary nutrient intakes for the future. In the interim, limitations of the current food and nutrient data—largely due to their age and any changes in eating patterns that may have occurred—are acknowledged.

While the results of national nutrition surveys can be used to estimate the usual intake of population groups, it is important to note they cannot be used to describe the usual intake for individuals (Rutishauser 2000). See Chapter 9 for further information on food nutrition survey methodologies.

7.1 Data sources

1995 National Nutrition Survey

The 1995 NNS survey included 13,858 people aged 2 and over and used a 24-hour food recall method to provide a representative indication of food consumption. A second 24-hour recall was collected on a subset of respondents, and nutrient intakes from the first day were adjusted to estimate 'usual intake' by including information from the second 24-hour record.

This chapter presents mean dietary intakes and the proportion of the population consuming various foods according to remoteness (location) and different socioeconomic status areas (ABS 1999). Refer to the glossary for an explanation of remoteness areas and socioeconomic status.

2007 Children's survey

The 2007 Children's survey included just over 4,480 children aged 2–16 and used a 24-hour food recall method to derive estimates of food consumption (CSIRO & University of South Australia 2008). The sampling methodology was different to that used for the 1995 NNS.

Data on food intakes, physical activity levels and physical measurements were collected in the Children's survey which was conducted between February and August 2007. Data were collected in two stages: a computer-assisted personal interview, followed by a computer-assisted telephone interview 7–21 days later. This chapter presents mean food and nutrient intakes, as well as percentages of children meeting recommended intakes.





2007–08 National Health Survey

The 2007–08 NHS, conducted in 15,792 private dwellings, surveyed 20,788 people from various regions of Australia, except *Very remote* areas (ABS 2009f). Information was obtained for one adult and one child (aged 0 to 17) in each selected household over 11 months from August 2007 to July 2008.

This survey included information on a range of health and health-related topics, with some related to food intake. Information on usual fruit and vegetable consumption and milk type usually consumed is presented here.

2010 Australian National Infant Feeding Survey

The 2010 ANIFS provides the most current national data on infant feeding practices in Australia and other foods and drinks consumed by infants and toddlers (AIHW 2011d). The survey included information from mothers or carers of a representative sample of children aged 0–24 months, from October 2010 to February 2011. Responses were received for nearly 29,000 children from a starting sample of 52,000 children, representing a response rate of 55%. The survey used two data collection methods: a mail-out/mail-in questionnaire and an online option. This chapter presents results on different infant feeding practices, as well as information on maternal demographics.

The 2010 National Drug Strategy Household Survey

The 2010 NDSHS was conducted between late April and early September 2010. Data were collected from a national stratified random selection of households, using self-completion booklets and a 'drop and collect' methodology. More than 26,000 people aged 12 and over participated in the survey. Information was collected on participants' knowledge of, and attitudes towards, drugs (including alcohol), their drug consumption histories, and related behaviours. The results of the survey in relation to alcohol are in this chapter.

7.2 National dietary recommendations

The Australian Dietary Guidelines (Table 7.1) have been used as the basis for evaluating the eating patterns of Australians. Reported food consumption from the various surveys has been converted to serve sizes, where possible, and compared with the recommended daily serves from the food groups (Table 7.2) as outlined in the *Australian guide to healthy eating*. The NHMRC is revising the 2003 Australian Dietary Guidelines and anticipates these will be available in late 2012.

The Australian Dietary Guidelines recognise that no single food, with the exception of breast milk for about the first 6 months of life, provides all the nutrients needed for good health. Dietary patterns with a variety of nutritious foods are more likely to meet nutrient requirements and provide health benefits than restricted diets.





Table 7.1: Australian Dietary Guidelines

Dietary Guidelines for Australian adults	Dietary Guidelines for children and adolescents
Enjoy a wide variety of nutritious foods: • eat plenty of vegetables, legumes and fruits • eat plenty of cereals (including breads, rice, pasta and noodles), preferably wholegrain • include lean meat, fish, poultry and/or alternatives • include milks, yoghurts, cheeses and/or alternatives Reduced-fat varieties should be chosen, where possible • drink plenty of water	Encourage and support breastfeeding
and take care to: • limit saturated fat and moderate total fat intake • choose foods low in salt • limit your alcohol intake if you choose to drink • consume only moderate amounts of sugars and foods containing added sugars	Children and adolescents need sufficient nutritious foods to grow and develop normally
Prevent weight gain: be physically active and eat according to your energy needs	Growth should be checked regularly for young children
Care for your food: prepare and store it safely	Physical activity is important for all children and adolescents
Encourage and support breastfeeding	Enjoy a wide variety of nutritious foods. Children and adolescents should be encouraged to: • eat plenty of vegetables, legumes and fruits • eat plenty of cereals (including breads, rice, pasta and noodles), preferably wholegrain • include lean meat, fish, poultry and/or alternatives • include milks, yoghurts, cheese and/or alternatives (reduced-fat milks are not suitable for young children under 2, because of their high energy needs, but reduced-fat varieties should be encouraged for older children and adolescents) • choose water as a drink. Alcohol is not recommended for children
	and care should be taken to: • limit saturated fat and moderate total fat intake • low-fat diets are not suitable for infants • choose foods low in salt • consume only moderate amounts of sugars and foods containing added sugars
	Care for your child's food: prepare and store it safely

Source: NHMRC 2003a, 2003b.





Table 7.2: Recommended daily serves from the food groups for various Australian population groups

Population group (years)	Cereals	Vegetables	Fruit	Dairy	Meat and alternatives	Extra
4–7	3–7	2–4	1–2	2–3	0.5–1	1–2
8–11	4–9	3–5	1–2	2–3	1–1.5	1–2
12–18	4–11	4–9	3–4	3–5	1–2	1–3
Men 19–60	5–12	5–8	2–4	2–4	1–2	0–3
Women 19–60	4–9	4–7	2–3	2–3	1–1.5	0–2.5
Men 60 and over	4–9	4–7	2–3	2–3	1–1.5	0–2.5
Women 60 and over	3–7	4–6	2–3	2–3	1–1.5	0–2
Pregnant women	4–6	5–6	4	2	1.5	0–2.5
Breastfeeding women	5–7	7	5	2	2	0–2.5

Notes

1. See Box 7.3 and the glossary for serve size examples.
2. Extra foods listed in the AGHE include biscuits, cakes, soft drinks, ice cream, pies, hot chips, high-fat takeaway items, and chocolate.

Source: Smith et al. 1998.

7.3 Infant feeding

The Australian Dietary Guidelines recommend exclusive breastfeeding of infants until 6 months, with the introduction of solid foods at around 6 months and continued breastfeeding until 12 months—and beyond if both mother and infant wish (NHMRC 2003a). This guideline reflects the evidence of the many benefits to be gained from breastfeeding, including nutritional, health, social and economic benefits.

The WHO highlights that breastfeeding reduces child mortality and has health benefits that extend into adulthood. Breast milk protects infants from infectious and chronic diseases and promotes sensory and cognitive development. For mothers, it provides many positive health effects, such as reducing the risk of some cancers and osteoporosis, as well as encouraging bonding between mother and child (NHMRC 2003a).

In November 2009, the Australian Health Ministers' Conference endorsed the Australian National Breastfeeding Strategy 2010–15 with the objective of 'increasing the percentage of fully breastfed babies from birth to six months of age, with continued breastfeeding and complementary foods to twelve months and beyond' (Australian Health Ministers' Conference 2009).

The internationally recommended definitions of breastfeeding to guide breastfeeding data collection and reporting are in Box 7.1 (WHO 2008b).





Box 7.1: Definitions of breastfeeding

'Exclusive breastfeeding' requires that the infant receive only breast milk (including milk expressed or from a wet nurse), with the exception of oral rehydration solutions, drops or syrup (consisting of vitamins, minerals and medicines). This excludes non-human milk and formula.

'Predominant breastfeeding' requires that the infant receive only breast milk (including milk expressed or from a wet nurse) as the predominant source of nourishment. The infant may also receive water or water-based drinks, fruit juice, oral rehydration solutions and medicines, but no non-human milk or formula. Predominantly breastfed may also be referred to as **'fully breastfed'** in some sources.

'Complementary breastfeeding' requires that the infant receive breast milk (including milk expressed or from a wet nurse) and solid or semi-solid food. This means that the infant may receive any food or liquid, including non-human milk and formula, in addition to breast milk. Complementary breastfeeding may also be referred to as **'partial breastfeeding'** in some sources.

Source: WHO 2008b.

Breastfeeding

Due to lack of standardised measures and inconsistent use of definitions, it has been difficult to compare breastfeeding rates across Australian states and territories (Binns et al. 2009). To improve the consistency of breastfeeding data collections, the AIHW convened a workshop in December 2010, attended by academics, breastfeeding practitioners and policy makers, to gain consensus on a core set of national breastfeeding indicators. The six indicators agreed to are in Box 7.2.

Box 7.2: Core set of 6 national breastfeeding indicators

- Indicator 1: Proportion of children ever breastfed (for children aged 0–24 months).
- Indicator 2: Proportion of children breastfed at each month of age, 0–24 months.
- Indicator 3: Proportion of children exclusively breastfed to each month of age, 0–6 months.
- Indicator 4: Proportion of children predominantly breastfed to each month of age, 0–6 months.
- Indicator 5: Proportion of children receiving soft/semi-solid/solid food at each month of age, 0–12 months.
- Indicator 6: Proportion of children receiving non-human milk or formula at each month of age, 0–12 months.

Source: AIHW 2011e.

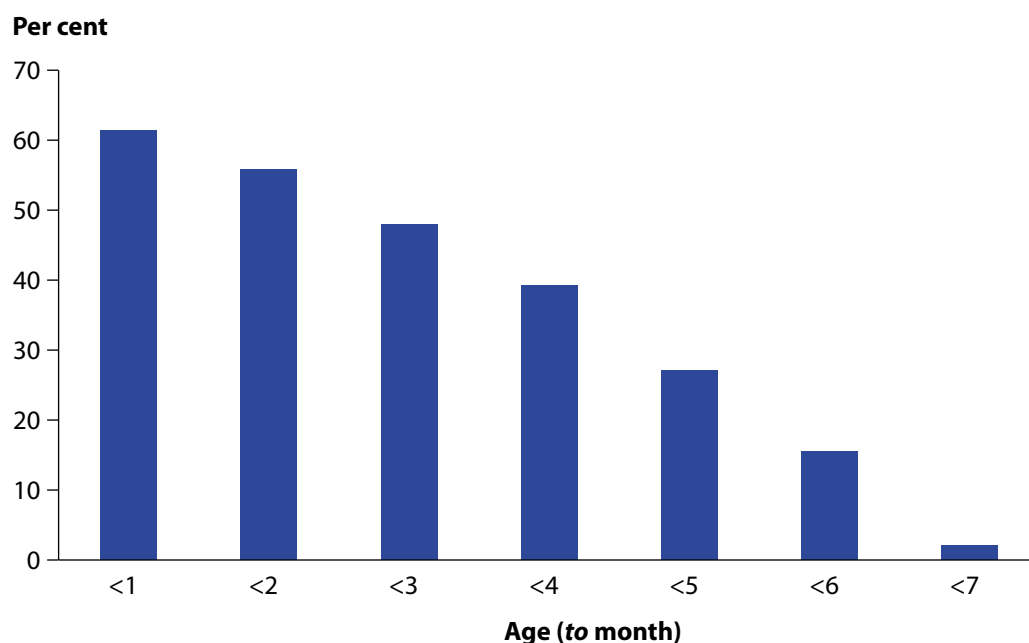
The 2010 ANIFS provides baseline results on the newly developed indicators at national and state and territory levels (AIHW 2011d). The survey showed:

- 96% of infants aged 0–2 years started breastfeeding (Indicator 1)
- 69% of infants were still receiving some breast milk at 4 months, and 60% at 6 months (Indicator 2)
- 39% of infants were exclusively breastfed to 3 months (less than 4 months), and 15% to 5 months (less than 6 months) (Indicator 3) (Figure 7.1)
- 47% of infants were predominantly (fully) breastfed for less than 4 months, dropping to 21% for less than 6 months (Indicator 4) (Figure 7.2)





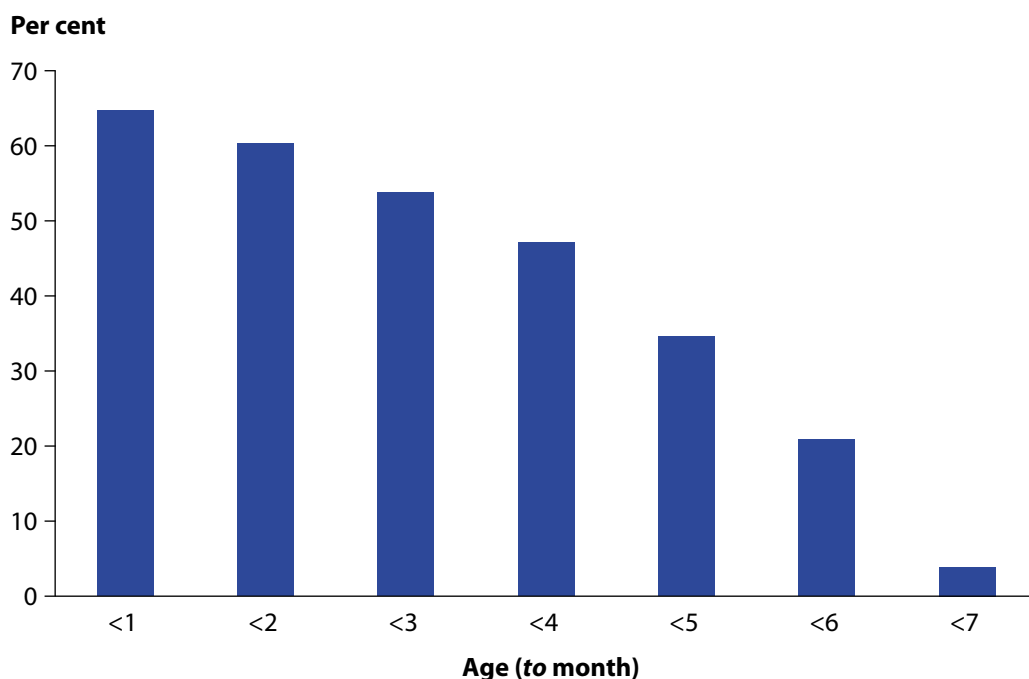
- fewer than 1% of infants aged 1 month had consumed soft/semi-solid/solid food (in the 24 hours before the survey), rising to 35% of infants aged 4 months, 92% of infants aged 6 months and 95% of children aged 12 months (Indicator 5)
- 40% of infants aged 1 month received non-human milk or infant formula, the rate rising gradually to 55% at 6 months and 80% by 12 months (Indicator 6).



Note: 'to month' refers to the completion of a whole month. For example, <4 months refers to 3 whole months being completed.

Source: AIHW 2011d.

Figure 7.1: Proportion of children exclusively breastfed to each month of age, 2010



Note: 'to month' refers to the completion of a whole month. For example, <4 months refers to 3 whole months being completed.

Source: AIHW 2011d.

Figure 7.2: Proportion of children predominantly breastfed to each month of age, 2010

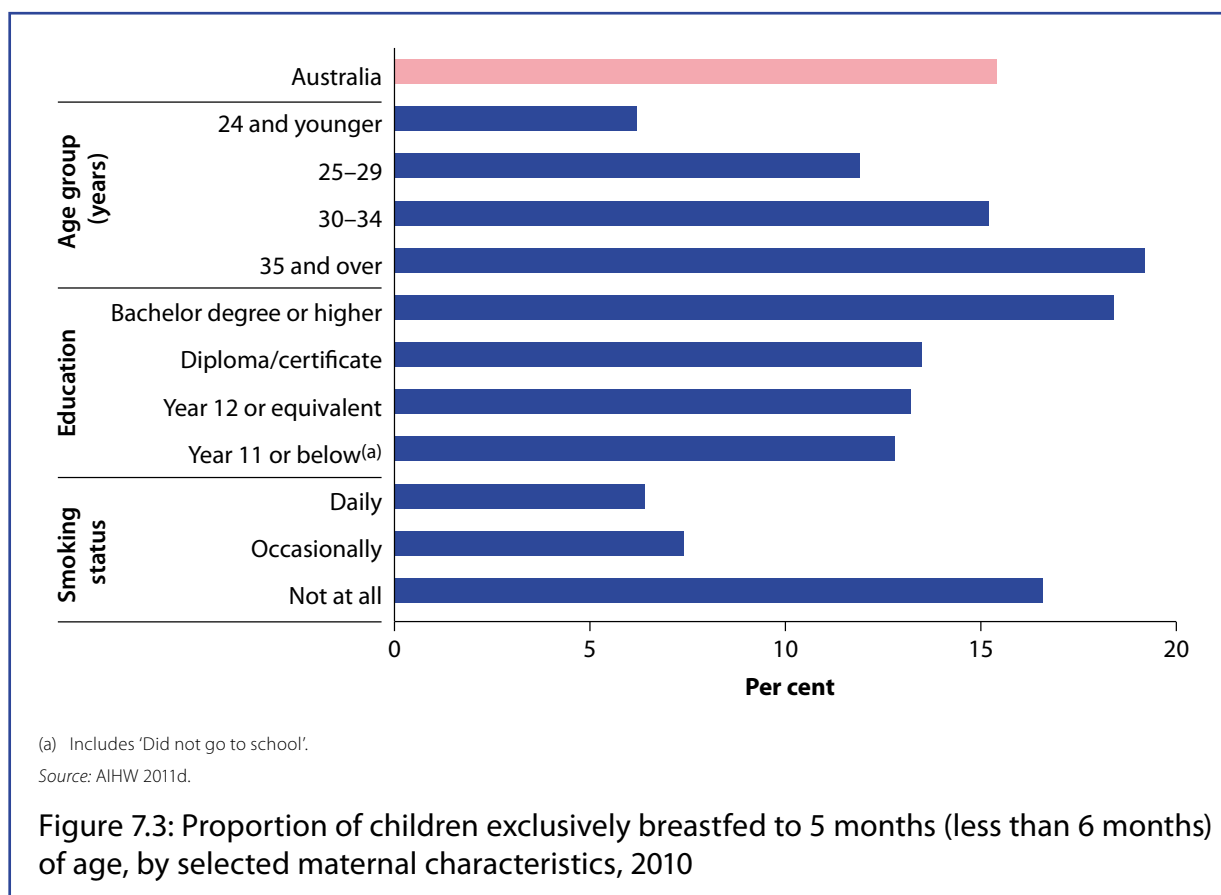




Exclusive breastfeeding

Rates of exclusive breastfeeding were associated with a number of maternal characteristics, including maternal age, education and smoking status (Figure 7.3). Mothers more likely to exclusively breastfeed to 6 months were:

- aged 35 and over compared with those aged 24 or younger (18% and 6% respectively)
- more highly educated (bachelor degree or higher level of education) compared with those who had completed Year 12 or below (18% and 13%)
- non-smokers compared with those who smoked daily (17% and 6%).



Rates of exclusive breastfeeding varied across population groups. Due to the small numbers in some groups exclusively breastfeeding at 6 months, rates have been examined by population group exclusively breastfeeding at 3 months (Figure 7.4).

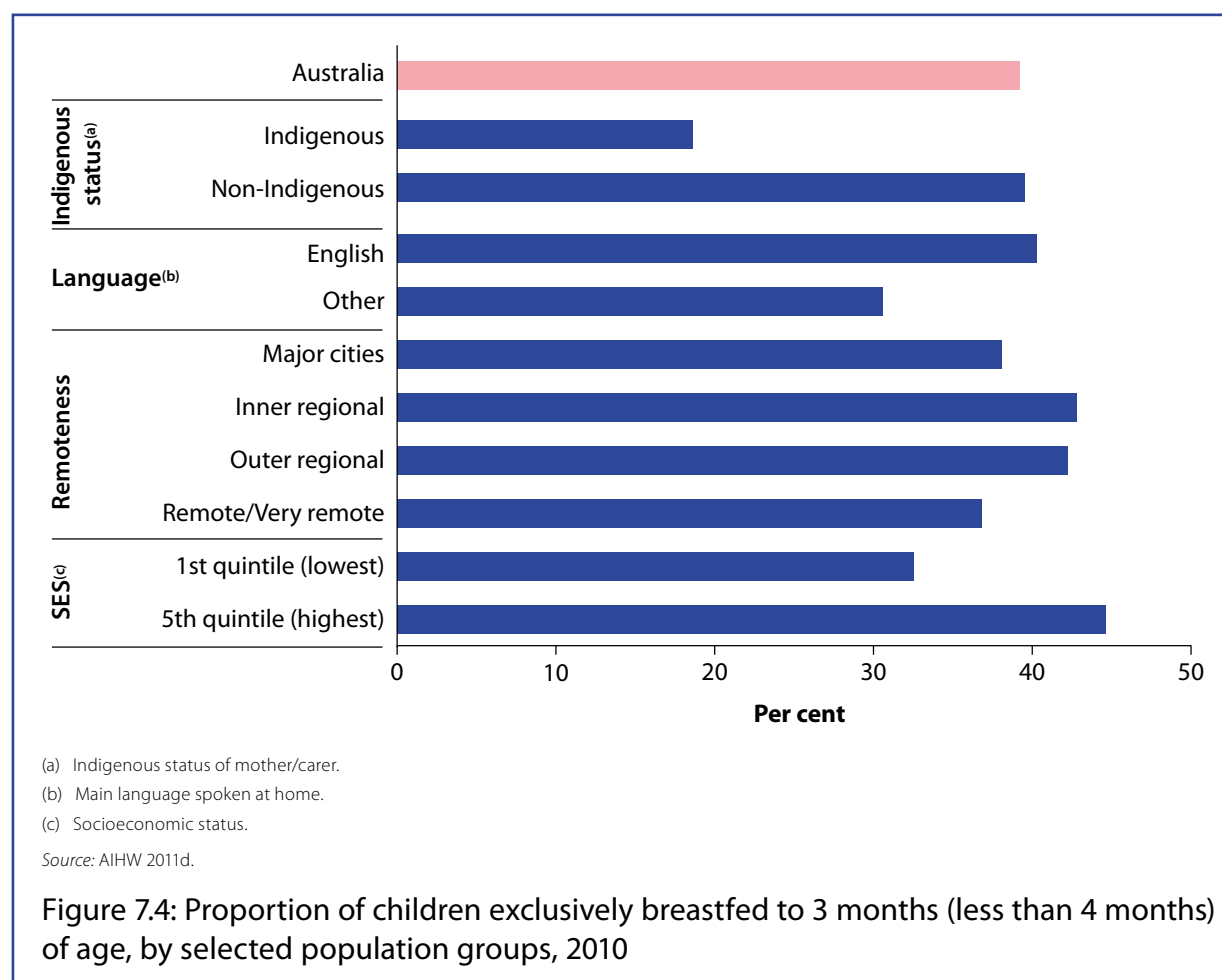
For Aboriginal and Torres Strait Islander infants, initiation rates of exclusive breastfeeding were slightly lower (87%) than non-Indigenous infants (90%). This difference increased with the infant's age, with Indigenous infants half as likely to be exclusively breastfed to 3 months as non-Indigenous infants (19% compared with 40%).

In homes where English was the main language spoken, the initiation rates of exclusive breastfeeding were slightly higher (91%), compared with infants in homes where a language other than English was mainly spoken (87%). Infants in homes where English was the main language spoken were 1.3 times more likely to be exclusively breastfed to 3 months (40%) as those in homes where a language other than English was mainly spoken (31%).



Initiation of exclusive breastfeeding was slightly higher for infants in *Remote/Very remote* areas (94%) than in *Major cities* (90%). By 3 months of age, rates were similar for *Remote/Very remote* areas (37%) and *Major cities* (38%), with slightly higher rates for infants in *Inner regional* (43%) and *Outer regional* (42%) areas.

Exclusive breastfeeding initiation rates were slightly higher for infants in the highest socioeconomic status areas (92%) compared with the lowest areas (88%). Infants in the highest socioeconomic status areas were 1.4 times as likely to be exclusively breastfed to 3 months (45%) as infants in the lowest areas (33%).



Predominant breastfeeding

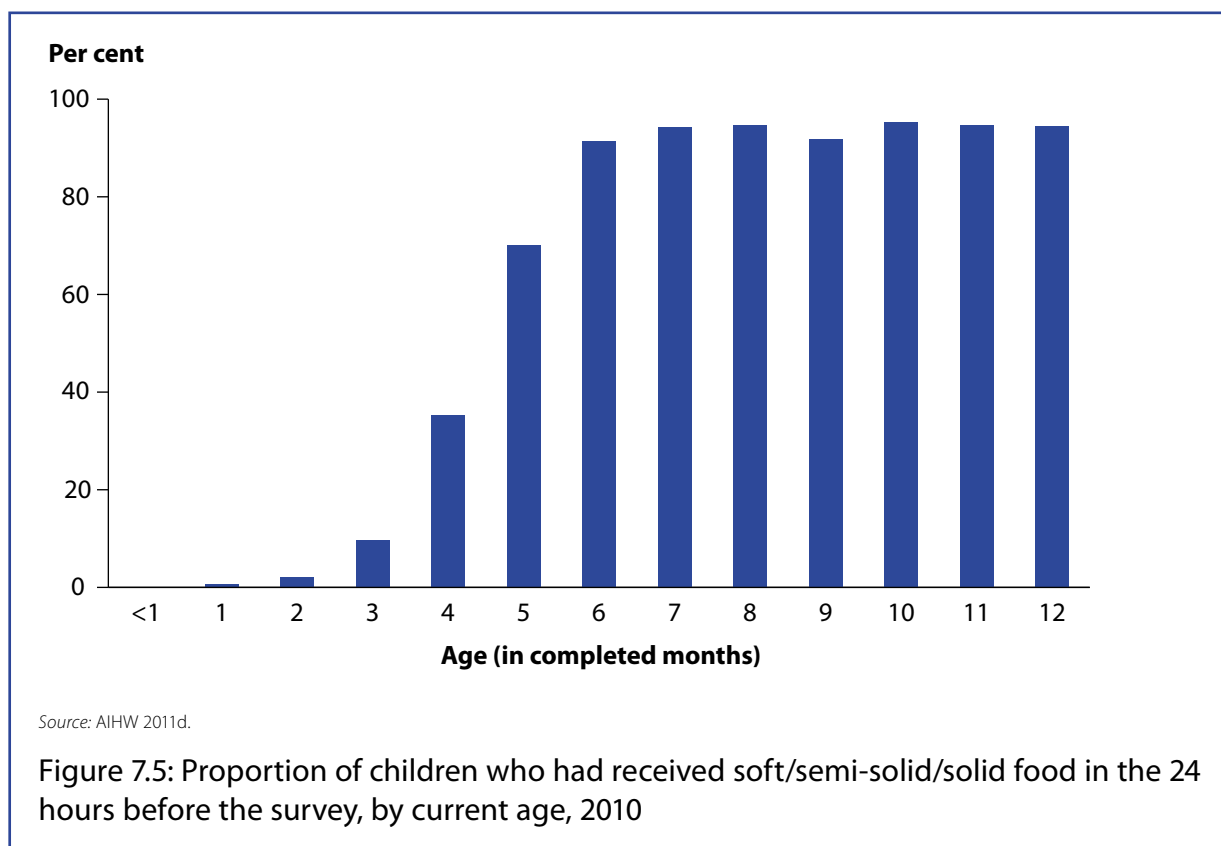
Rates for predominant breastfeeding were slightly higher each month when compared with exclusive breastfeeding rates. However, both rates followed a similar downwards trajectory (see Figures 7.1 and 7.2). The maternal characteristics associated with predominant breastfeeding were similar to those reported for exclusive breastfeeding, that is, maternal age, education and smoking status (AIHW 2011d).





Introducing solid foods

The Infant Feeding Guidelines for Health Workers recommend introducing solid foods at around 6 months but not before 4 months to meet the infant's increasing nutritional and developmental needs (NHMRC 2003b). The 2010 ANIFS showed that, by 1 month of age, fewer than 1% of infants had been introduced to solid foods. This increased to 10% by 3 months, 35% by 4 months and 92% by 6 months (Figure 7.5).

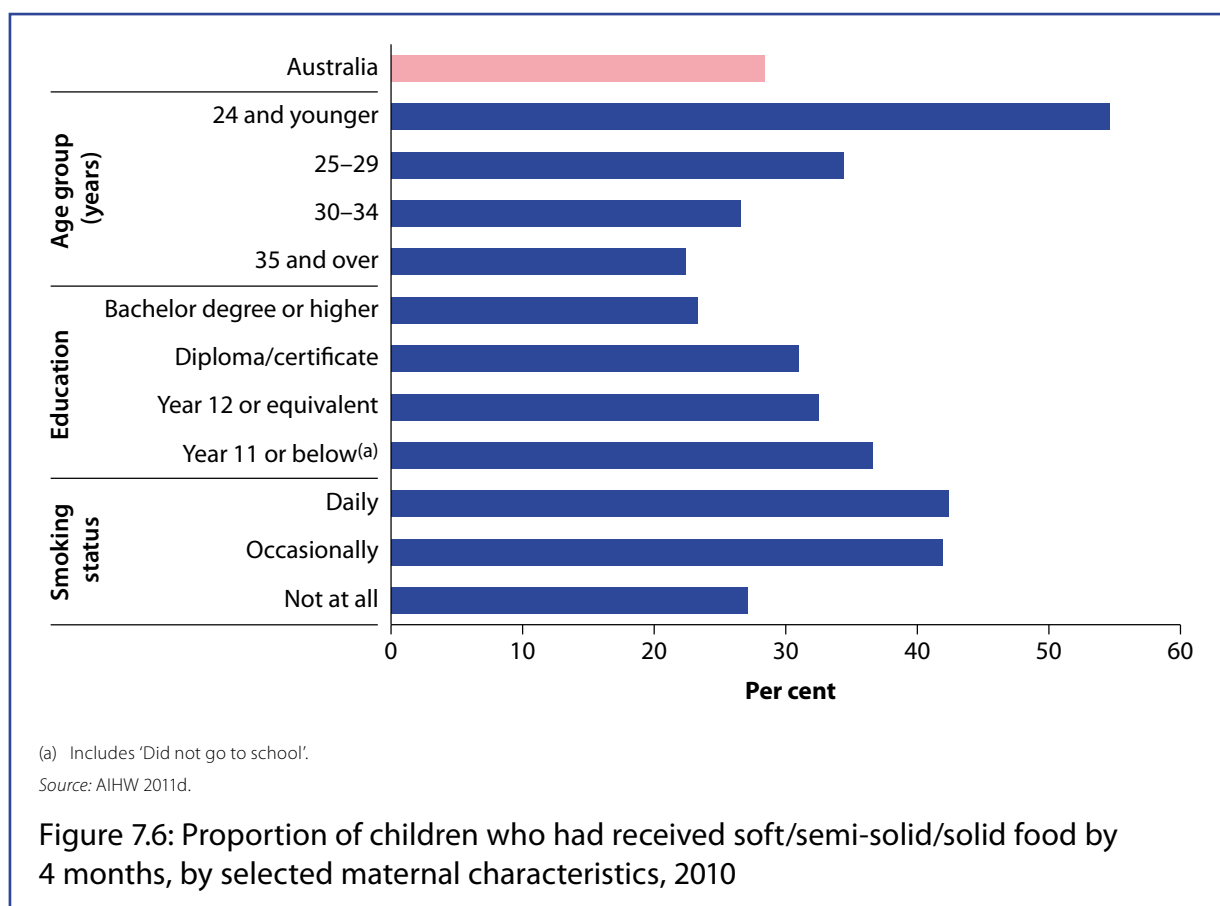


The data in Figure 7.5 are based on a child having received soft/semi-solid/solid food in the 24 hours before the survey. This time constraint was removed when undertaking further analysis investigating maternal characteristics associated with introducing solids, so the results in Figure 7.5 differ from those in Figure 7.6.

Mothers less likely to introduce solids by 4 months were:

- aged 35 and over compared with mothers aged 24 and younger (22% and 55% respectively)
- more highly educated (bachelor degree or higher level of education) compared with mothers who had completed Year 12 or below (23% and 33%)
- non-smokers compared with mothers who smoked daily (27% and 42%).

There was no clear pattern for introducing solids by socioeconomic status, state or territory, or geographical remoteness.



7.4 Food intakes

Vegetables, legumes and fruit

The Australian Dietary Guidelines encourage people to eat sufficient quantities of vegetables (including different types and colours), legumes/beans and fruit. This advice reflects evidence showing that people who regularly eat diets high in vegetables, legumes and fruit have a lower risk of developing certain health conditions, such as coronary heart disease, stroke, cancer and Type 2 diabetes (NHMRC 2003a). These foods are nutrient rich, relatively low in energy (kilojoules) and contain fibre to promote health.

The *Australian guide to healthy eating* recommends consumption of 2–8 serves of vegetables and legumes and 1–5 serves of fruit a day, depending on the population group (see Table 7.2). In health promotion messages, this is generally interpreted as two serves of fruit and five serves of vegetables (Box 7.3).





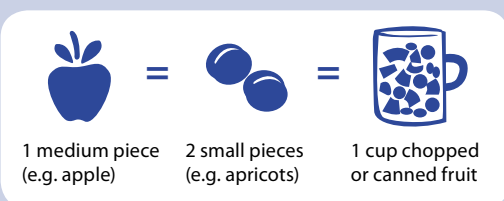
Box 7.3: What is a serve of fruit and vegetables?

By convention, a serve of fruit is 150 grams, and a serve of vegetables is 75 grams. Some examples of a serve are:

Fruit

- 1 medium apple, orange, banana
- 2 items of small fruit such as apricots, plums
- About 8 strawberries
- 1 cup of canned fruit
- About 20 grapes or cherries

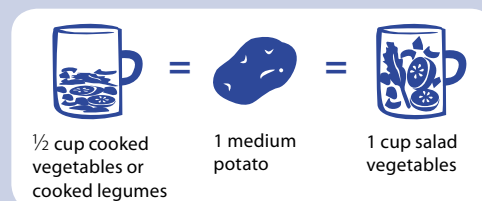
One serve of fruit can be:



Vegetables

- 1 medium potato
- 1 cup of salad vegetables
- ½ cup cooked vegetables or legumes

One serve of vegetables can be:

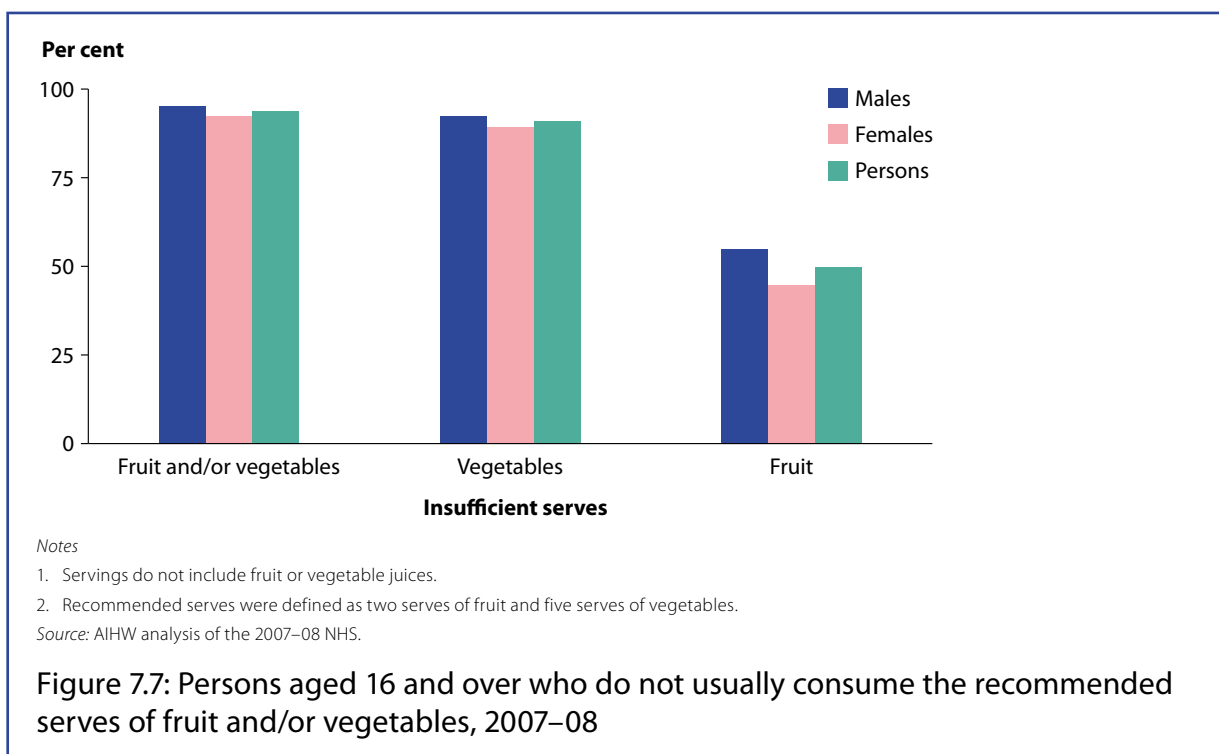


Note: See glossary for serve size examples for all food groups.

Source: Adapted from NHMRC 2003a.

2007–08 NHS

The most recent national data on vegetable and fruit consumption are from the 2007–08 NHS. This showed that more than 9 in 10 (91%) people aged 16 and over do not consume sufficient serves of vegetables, and about half do not consume sufficient serves of fruit (Figure 7.7). When measures of sufficient serves of fruit and vegetables are combined, only 6% of people consume enough fruit and vegetables on a usual basis. Overall, females were more likely than males to report sufficient serves of fruit.

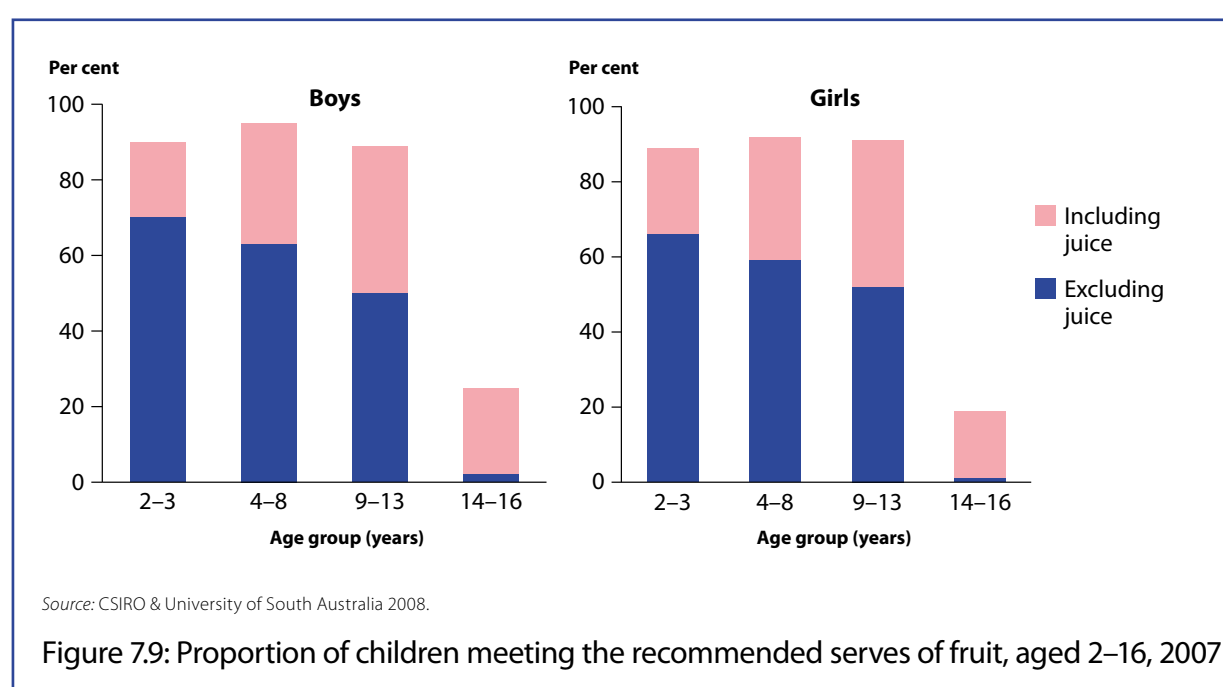
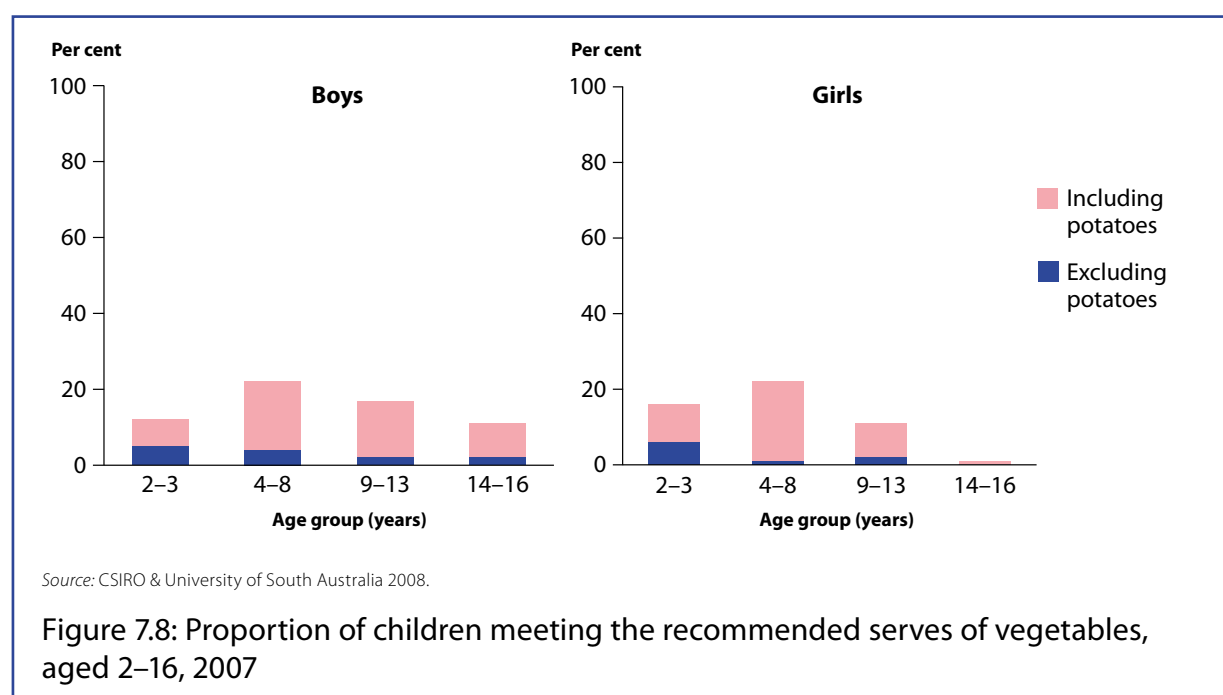




2007 Children's survey analysis

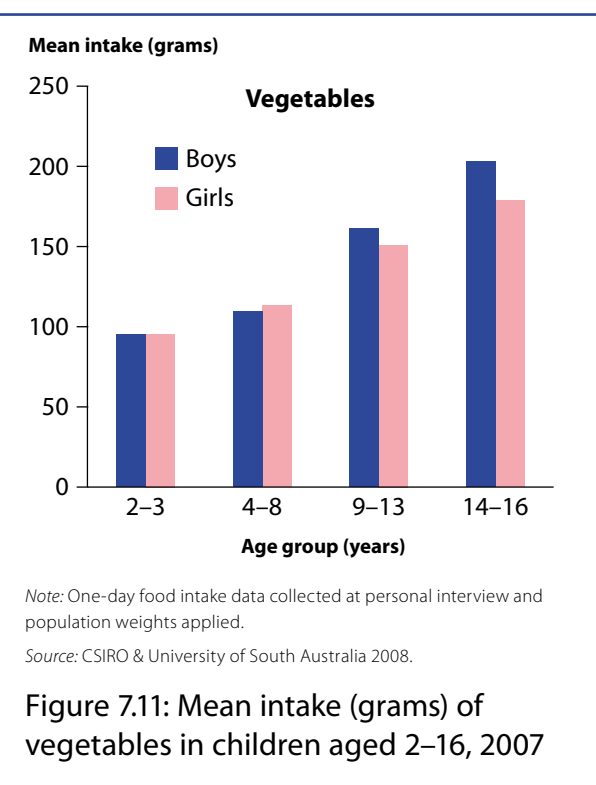
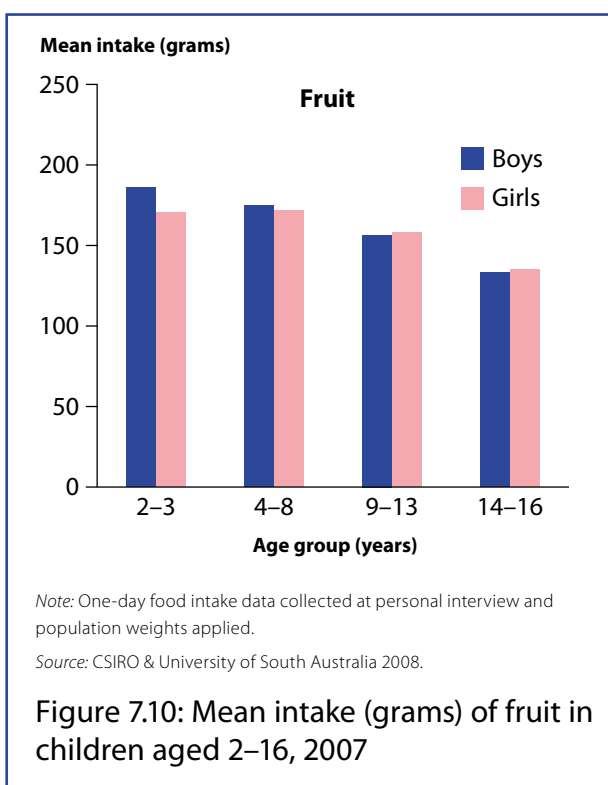
Vegetable and fruit intakes from the 2007 Children's survey were assessed against the recommendations for children aged 2–16 (1–3 serves fruit; 2–4 serves of vegetables) (CSIRO & University of South Australia 2008). A total of 22% of boys and girls aged 4–8 met the recommended serves of vegetables but this decreased to 11% of boys and 1% of girls aged 14–16 (Figure 7.8). When potatoes were excluded from the analysis, no girls and only 2% of boys aged 14–16 met the recommendation. Potato consumption was highest among 4–8 year olds.

About 9 in 10 children aged 2–13 met the recommendation for fruit serves compared with only 1 in 4 boys aged 14–16 (25%) and about 1 in 5 girls (19%) (Figure 7.9). This decreased substantially when fruit juice was excluded from the analysis, with only 2% of boys and 1% of girls aged 14–16 meeting the recommendation.





In the specific age categories, mean intakes of fruit and vegetables were similar for boys and girls. However, fruit intake was higher in younger age groups and decreased with age. This trend was reversed for vegetable intake (figures 7.10 and 7.11)



1995 NNS analysis

Results from the 1995 NNS also showed that mean intakes of vegetables, legumes and fruit in the population, when converted to the number of serves per day, were well below recommended levels (Table 7.3). Minimal difference in vegetable consumption between the sexes was noted but the proportion consuming vegetables increased slightly with age (Figure 7.12). More variation in fruit consumption was observed, with women consuming more than men and the proportion generally increasing with age, to a high of about 70% of the population aged 65 and over. Those aged 19–24 had the lowest consumption. The proportion of the population consuming legume and pulse products was generally low (ABS 1999).

Table 7.3: Mean daily fruit, vegetable and legume intakes, people aged 19 and over, 1995

Measure	Men	Women	Recommended intake (serves)
	(grams/person/day)		
Vegetable products and dishes ^(a)	295.6	242.4	375 (5 serves)
Fruit products and dishes ^(b)	141.3	145.7	300 (2 serves)
Fruit and vegetable juices and drinks	139.5	109.4	n.a.

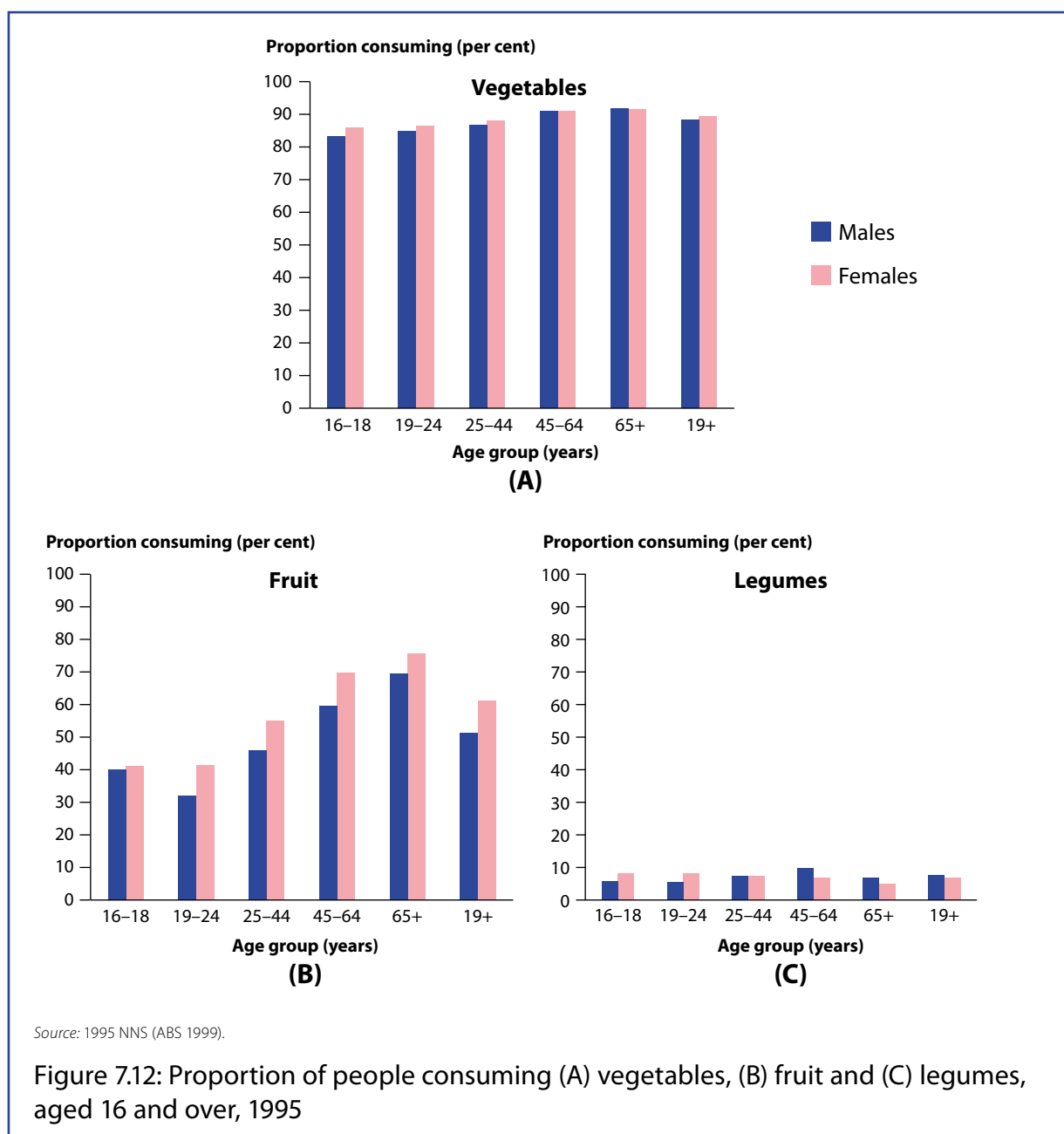
(a) Includes potatoes, and legumes and pulse products and dishes.

(b) Excludes fruit juice.

Note: Data from the 1995 NNS, from a single 24-hour recall.

Source: ABS 1999.



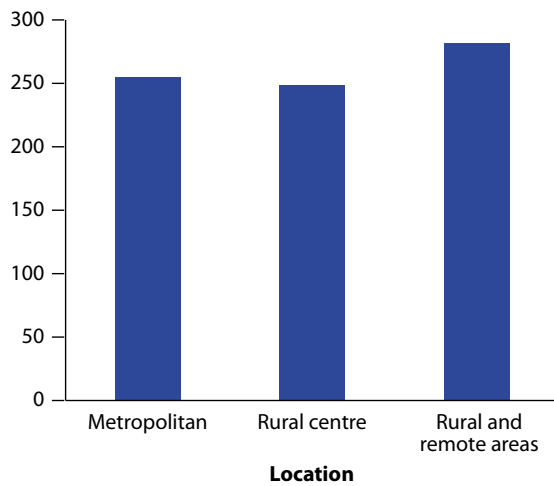


The mean intake of vegetables for people aged 19 and over was slightly higher in rural and remote areas but similar between people in different socioeconomic status areas (Figure 7.13). In contrast, the mean intake of fruit for this age group was similar between locations, but lowest for people in the most disadvantaged areas and highest for people in the least disadvantaged areas (Figure 7.14).

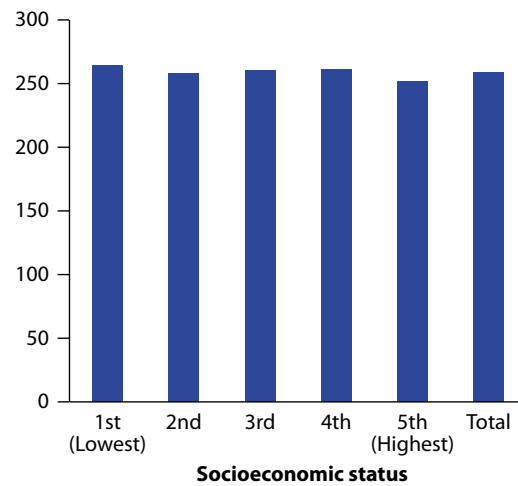




Mean intake (grams)



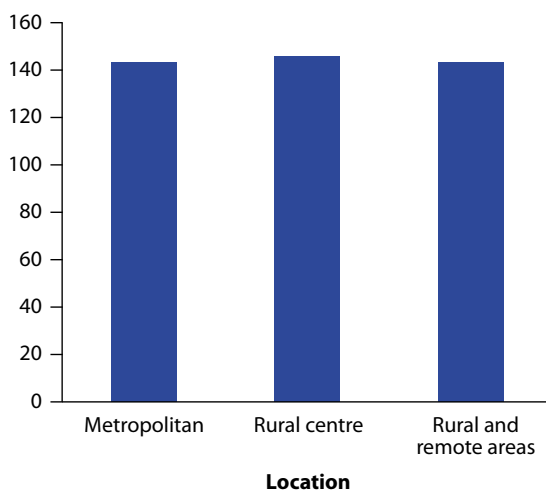
Mean intake (grams)



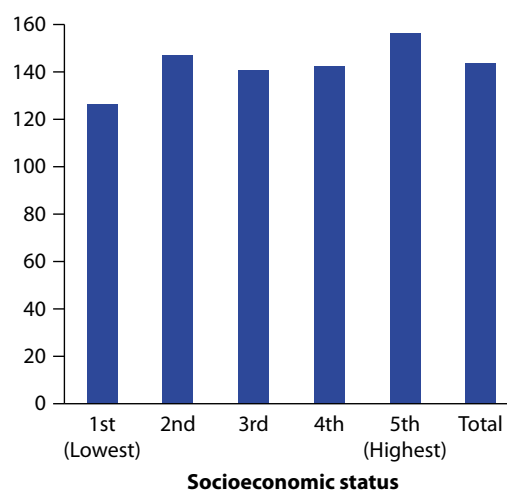
Source: 1995 NNS (ABS 1999).

Figure 7.13: Mean intake (grams) of vegetables according to location and socioeconomic status in people aged 19 and over, 1995

Mean intake (grams)



Mean intake (grams)



Source: 1995 NNS (ABS 1999).

Figure 7.14: Mean intake (grams) of fruit according to location and socioeconomic status in people aged 19 and over, 1995





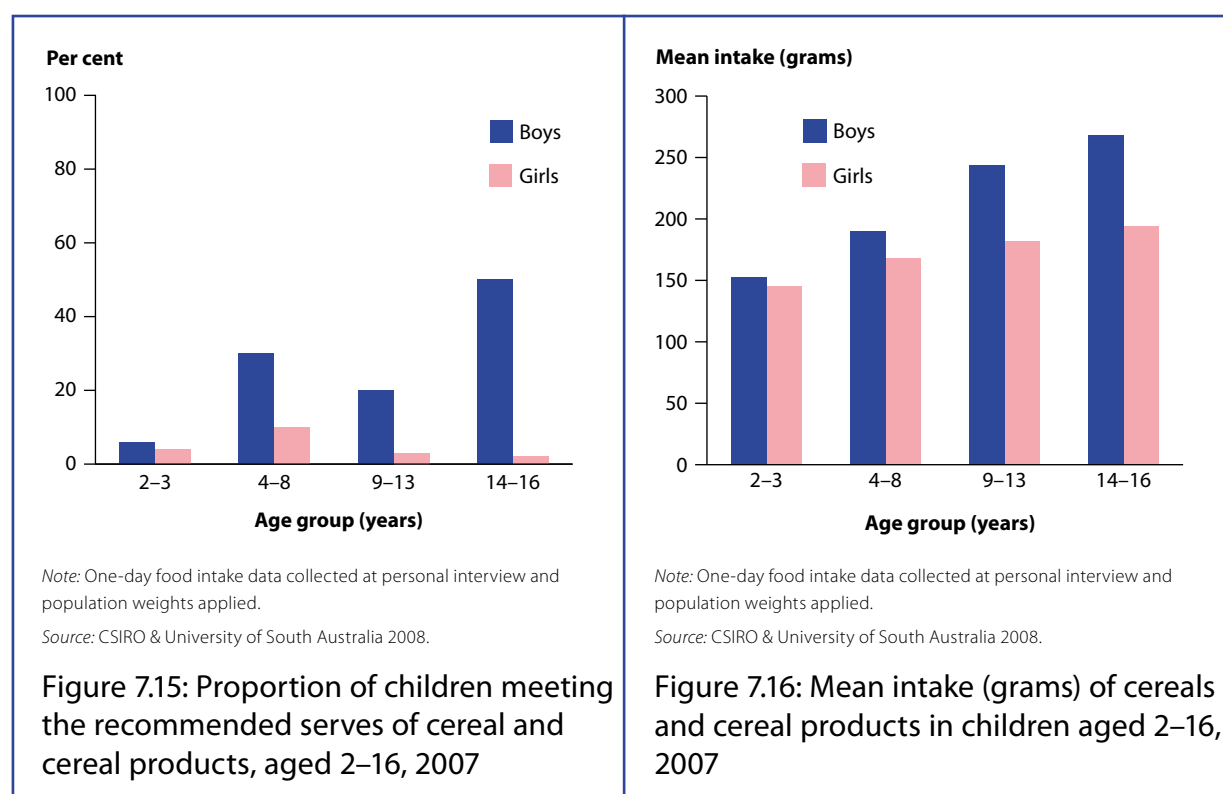
Cereals

The Australian Dietary Guidelines advise people to include cereals, preferably wholegrain, in their diet. This reflects evidence of the beneficial health effects of cereal fibre and whole grains, including a possible decreased risk of coronary heart disease and some cancers, and improved bowel health (NHMRC 2003a).

2007 Children's survey analysis

Cereal intakes from the 2007 Children's survey were assessed against the recommendations for children aged 2–16 (3–4 serves per day). Based on the *Australian guide to healthy eating*, one serve of cereal is equivalent to 40 grams of breakfast cereal or 60 grams of bread (2 slices) or 180 grams of cooked rice or pasta (Smith et al. 1998). Note, serving sizes are not specified for 2–3 year-olds but in the 2007 Children's Survey they were assigned the recommended serves for 4–8 year-olds.

There was considerable variation across age and sex, with few children aged 2–3 meeting the recommendation (6% boys; 4% girls) as well as girls aged 9–13 (3%) and 14–16 (2%) (Figure 7.15). Intake was highest in boys aged 14–16 (25%). Boys ate more cereal foods than girls and this difference increased with age (Figure 7.16). In general, boys eat more of all foods and have higher energy requirements than girls, especially as they reach puberty.



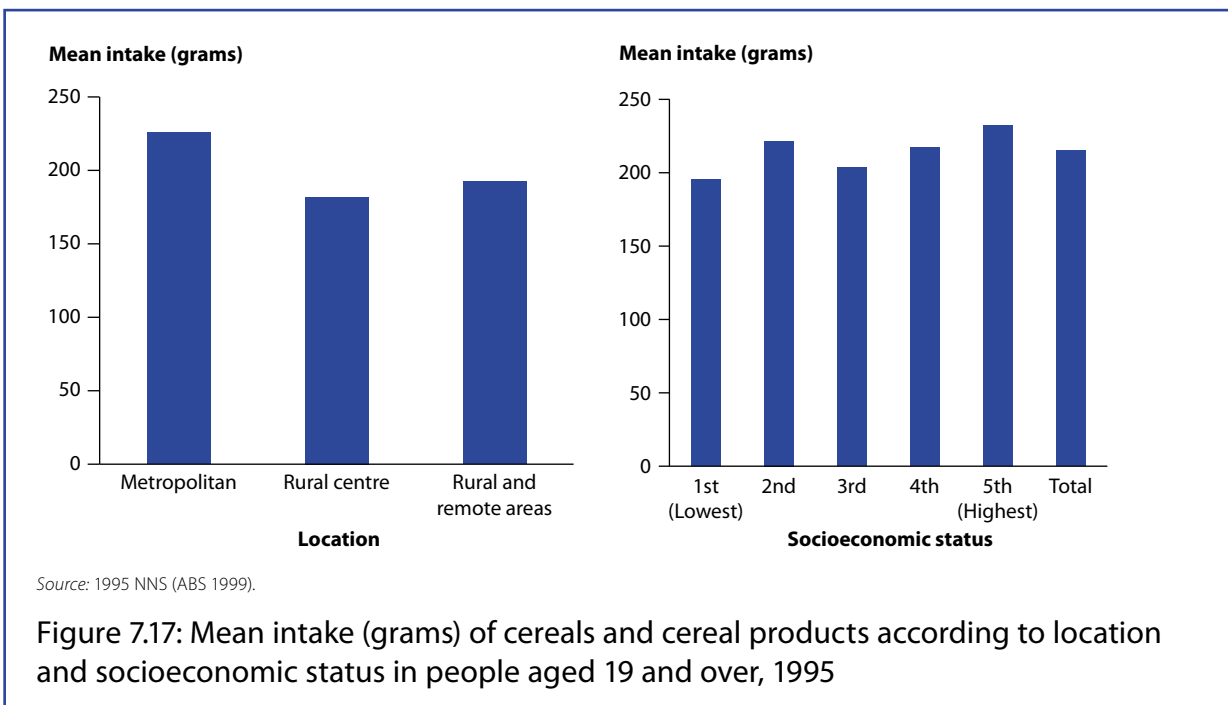


1995 NNS analysis

Results from the 1995 National Nutrition Survey provide mean intakes and the proportion of the population consuming cereal and cereal products and cereal-based products and dishes over a 24-hour period (ABS 1999).

More than 90% of the population consumed cereals and cereal products and there was minimal difference between males and females, although males generally consumed more in all age groups. Consumption of cereal-based products and dishes was about 60–70% for males and females across the age groups. These data do not provide an indication of the types of cereal products consumed so the proportion meeting the recommended serves cannot be determined. Further, analysis against the wholegrain recommendation cannot be undertaken.

Mean intake of cereals and cereal products varied between people in different locations and socioeconomic areas; the highest intakes were in metropolitan areas and in those living in areas of least disadvantage (Figure 7.17).



Meat, fish, poultry and/or alternatives

The Australian Dietary Guidelines recommend including lean meat, fish, poultry and/or alternatives as these foods are sources of protein, zinc, vitamin B12 and, in the case of fish, omega-3 fatty acids. Importantly, most also provide a source of highly absorbable iron (NHMRC 2003a).

2007 Children's survey analysis

Generally, intakes of meat, poultry and game increased with children's age, with boys having higher intakes than girls from the age of 4.

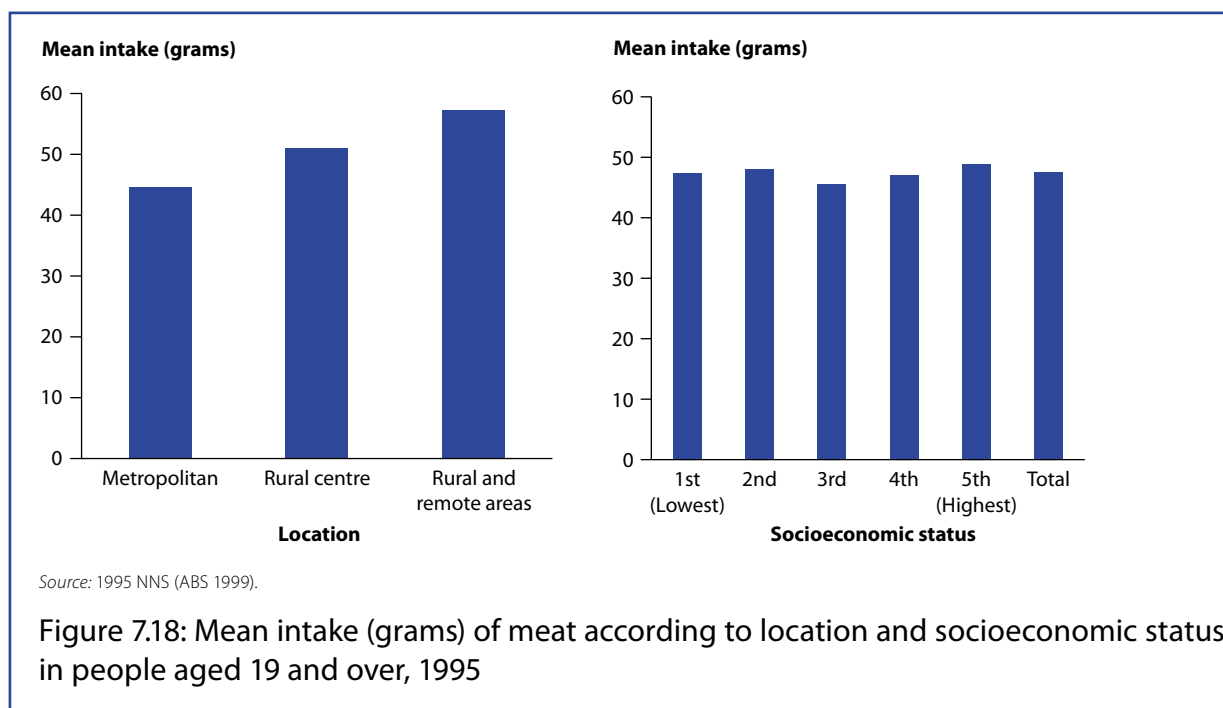


1995 NNS analysis

Results from the 1995 NNS provide mean intakes and the proportion of the population consuming meat, poultry, fish and seafood products and dishes, and egg products and dishes over a 24-hour period (ABS 1999). About 50% of males aged 19 and over consumed muscle meat (for example, beef, corned beef, lamb, pork, bacon, ham or veal) on the survey day, but the proportion was lower in women, varying from 37% for those aged 19–24 to 46% for those 65 and over. Consumption of poultry was 13–22% for men and women across the age groups. However, these data do not indicate whether the meat was lean.

The proportion of people consuming fish on the survey day ranged from 9% to 21% and was similar between males and females. As the Australian Dietary Guidelines recommend 2–3 fish serves per week, many people are not meeting this recommendation. More males than females consumed egg products and dishes on the survey day; however, consumption was at or below 21% across the age groups.

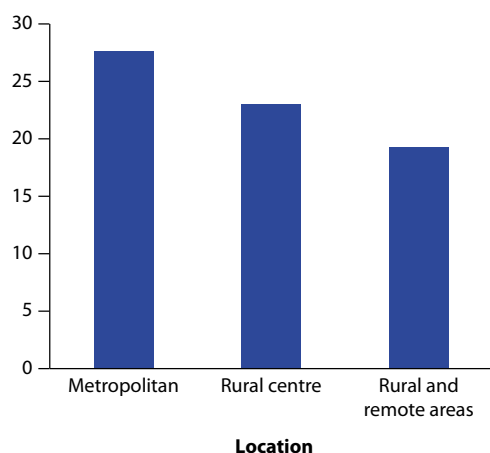
Mean intake of meat was highest in rural and remote areas. However, there was minimal difference between people in different socioeconomic status areas (Figure 7.18).



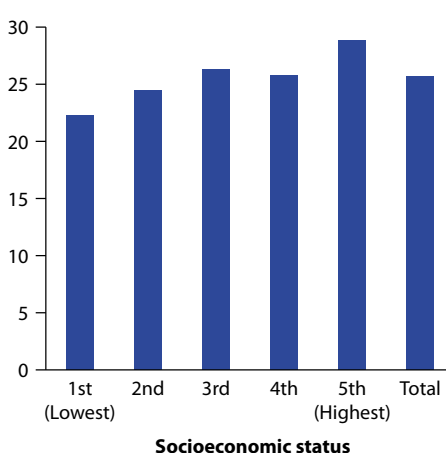
Mean intake of seafood products and dishes was highest for people in metropolitan areas and in areas of least socioeconomic disadvantage, possibly a reflection of the increased availability of seafood in coastal areas, where the main cities are (Figure 7.19).



Mean intake (grams)



Mean intake (grams)



Source: 1995 NNS (ABS 1999).

Figure 7.19: Mean intake (grams) of fish and seafood according to location and socioeconomic status in people aged 19 and over, 1995

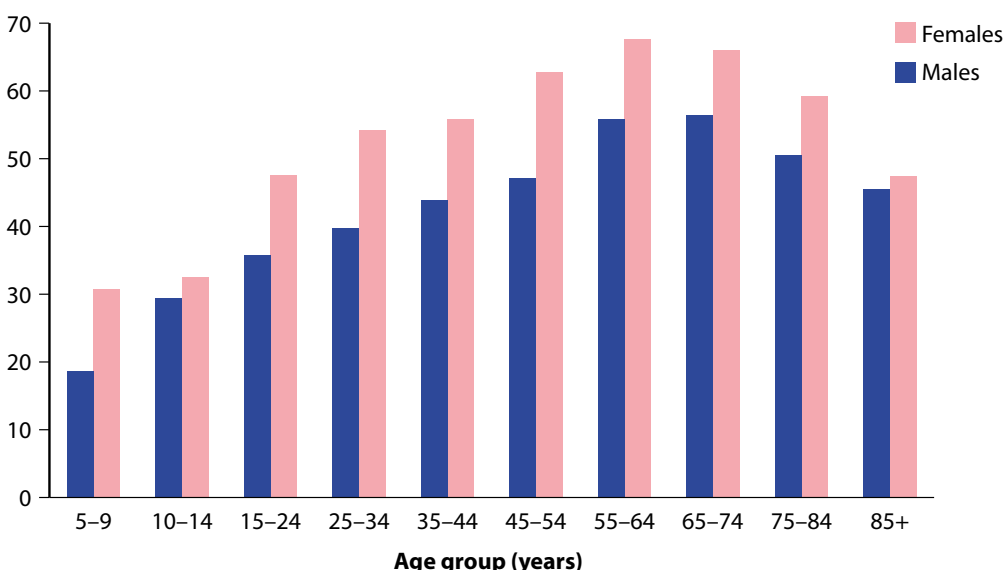
Milks, yoghurts, cheeses and/or alternatives

The Australian Dietary Guidelines recommend including milks, yoghurts, cheeses and/or alternatives as these foods are a major source of calcium and also provide protein, vitamin A, riboflavin, vitamin B12 and zinc. They include a further recommendation that reduced-fat varieties should be chosen where possible, except for children under 2 (NHMRC 2003a).

2007–08 NHS

The 2007–08 NHS collected data on the type of milk consumed, including full fat, reduced fat and skim. Of the population consuming milk, females were more likely than males to consume reduced-fat or skim milk and the proportion increased with age (Figure 7.20).

Per cent



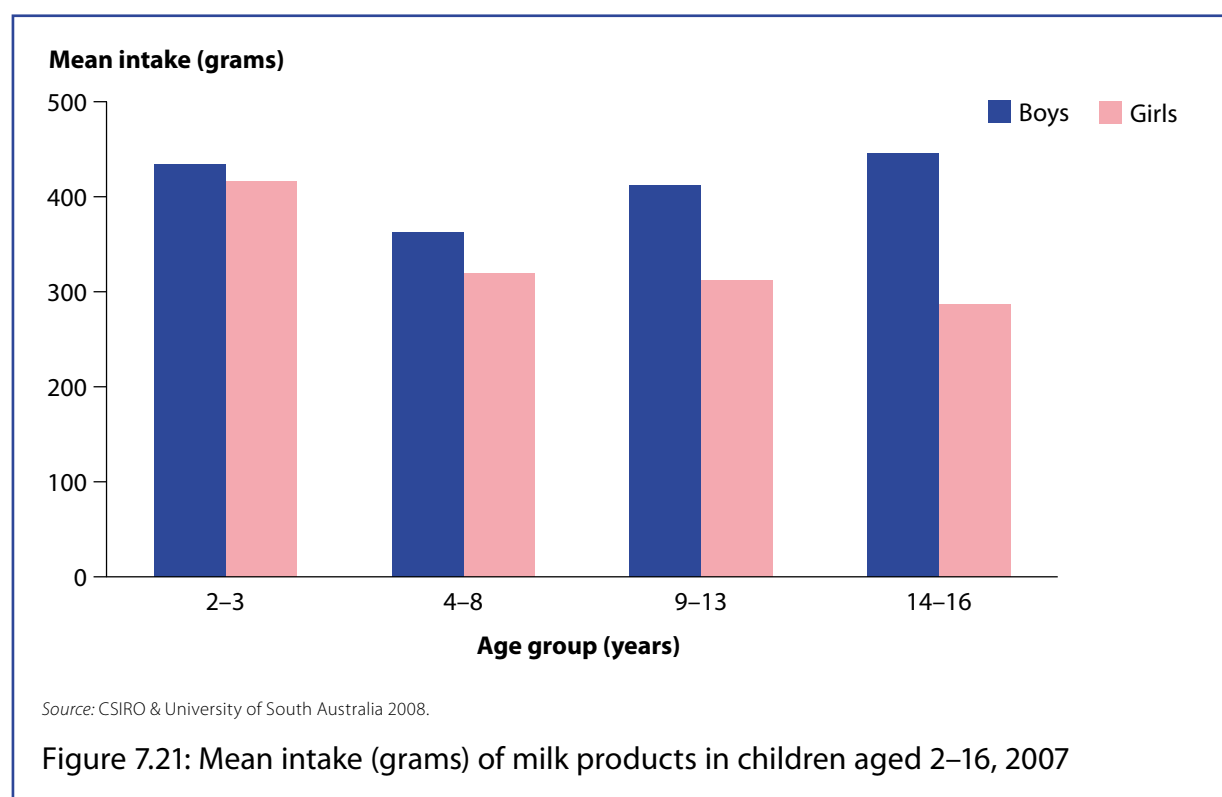
Source: AIHW analysis of 2007–08 NHS.

Figure 7.20: Proportion of milk consumers who choose reduced-fat/skim milk, aged 5 and over, 2007–08



2007 Children's survey analysis

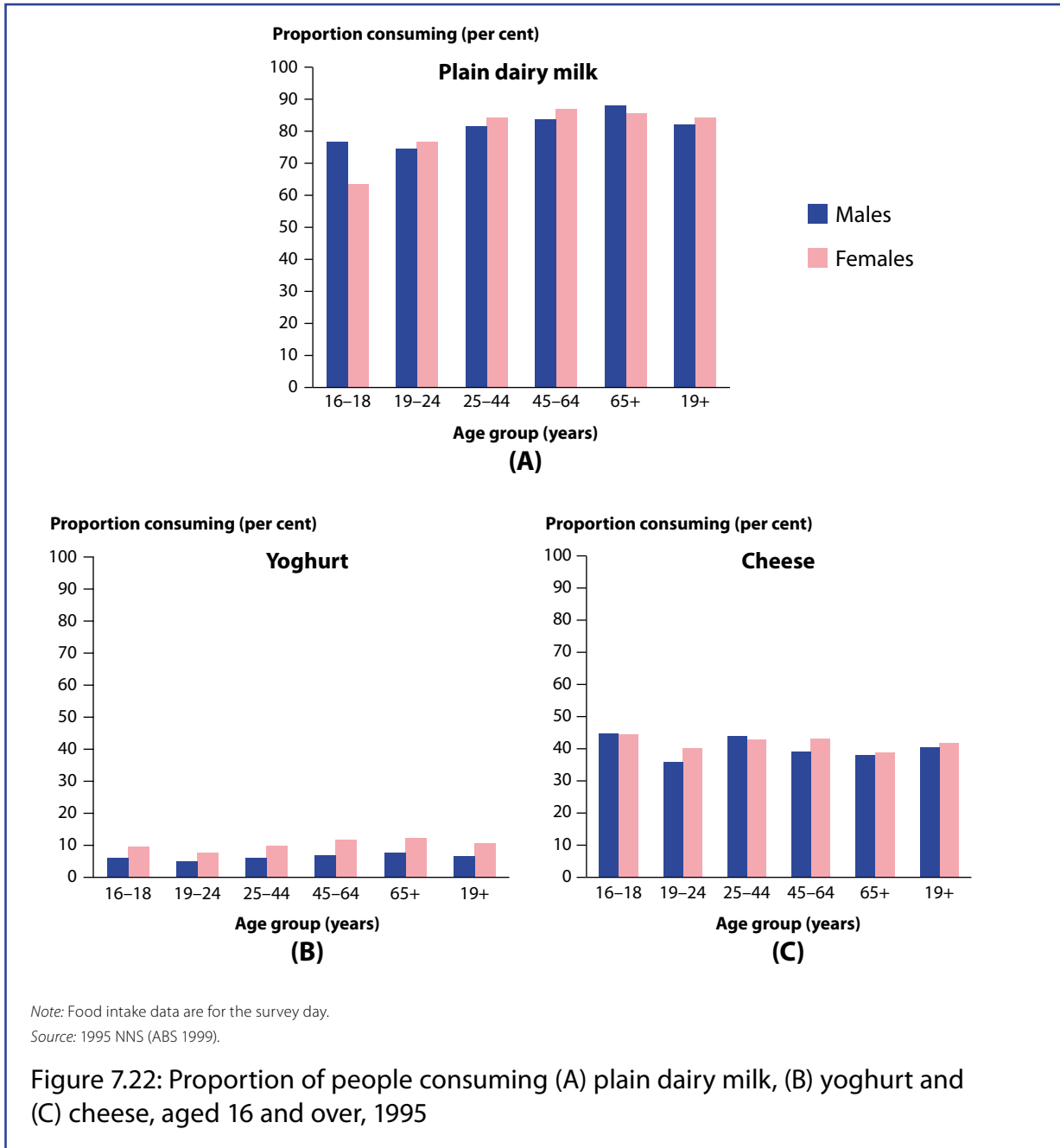
Unlike boys, milk consumption decreased in older girls (Figure 7.21). As girls grow older, milk consumption decreases partly due to increasing amounts and variety of other foods.



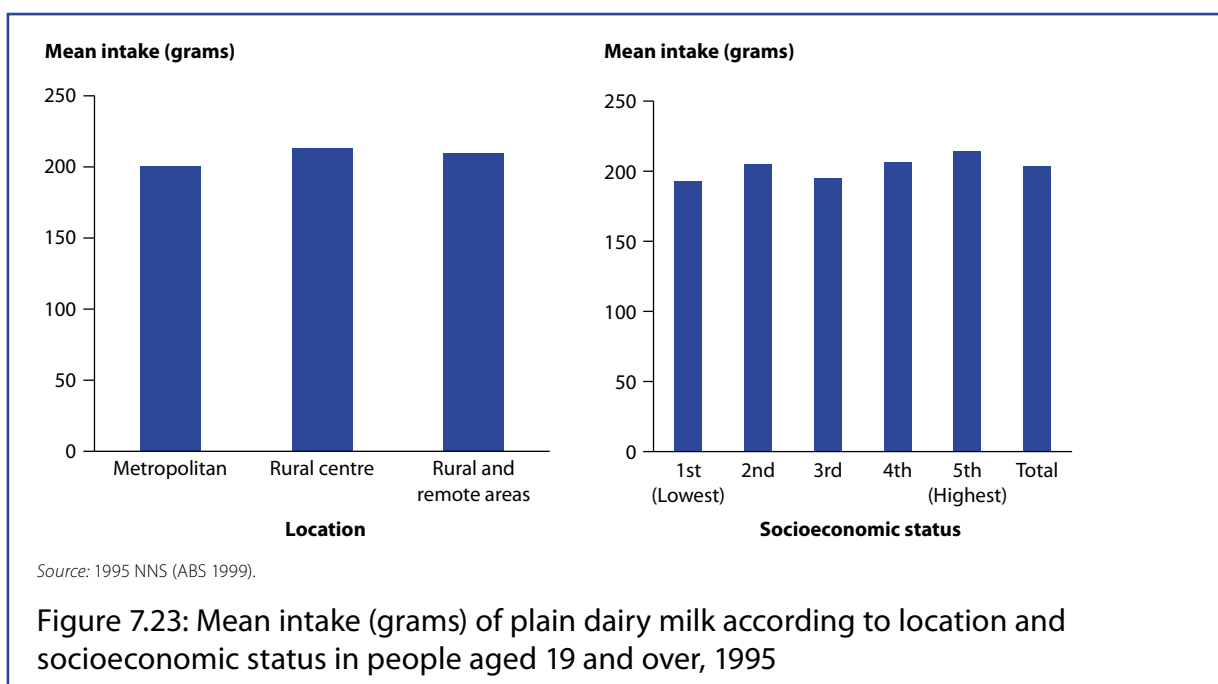
1995 NNS analysis

Results from the 1995 NNS provide mean intakes and the proportion of the people consuming plain dairy milk, yoghurt and cheese over a 24-hour period (ABS 1999). Between 75% and 88% of males aged 16 and over consumed plain dairy milk, with the highest proportion reported for those aged 65 and over (Figure 7.22). The proportion consuming plain dairy milk was lower for females, ranging from 64% to 87%, and the highest proportion reported was for those aged 45–64. More females than males consumed yoghurt on the survey day; however, the proportion was less than 12% across the age and gender groups. Cheese consumption was similar for males and females across the age groups with about 40% consuming on the survey day.





There was minimal difference in intake of plain dairy milk between locations but consumption was highest in areas of least socioeconomic disadvantage (Figure 7.23).



Alcohol

The Australian Dietary Guidelines recommend limiting alcohol intake in acknowledgement of the many medical and social complications that can arise through alcohol consumption, both acute and long term (NHMRC 2003a). The revised *Australian guidelines to reduce the health risks from drinking alcohol* (NHMRC 2009) provide more detailed and up-to-date information (Box 7.4). Alcoholic beverage consumption also contributes to energy intake; this is discussed in Section 7.5.

Box 7.4: Alcohol consumption guidelines

There are four guidelines in the *Australian guidelines to reduce the health risks from drinking alcohol*:

1. For healthy men and women, drinking no more than two standard drinks on any day reduces the lifetime risk of harm from alcohol-related disease or injury.
2. For healthy men and women, drinking no more than four standard drinks on a single occasion reduces the risk of alcohol-related injury (arising from that occasion).
3. If you are under 18 years of age, not drinking alcohol is the safest option.
4. If you are pregnant, planning a pregnancy or are breastfeeding, not drinking alcohol is the safest option.

These relate to long-term (lifetime) health risk, short-term risk of injury from a single-occasion drinking, underage risk, and risk during pregnancy and breastfeeding from drinking alcohol. Risky drinking behaviour relates to drinking at levels above those recommended.

What is a standard drink?

A standard drink contains 10 grams (12.5 millilitres) of pure alcohol. The label on an alcoholic drink container states how many standard drinks it contains. For example, there are:

- 34 standard drinks in a case of full-strength beer
- 7–8 standard drinks in a bottle of red wine, white wine or champagne
- 22 standard drinks in a 700ml bottle of high-strength spirits.

Further information can be found at: <www.alcohol.gov.au>.





2010 National Drug Strategy Household survey

The proportion of the population aged 14 or over who consumed alcohol daily declined slightly between 2007 (8%) and 2010 (7%) (Table 7.4) (AIHW 2011f). In 2010, males were twice as likely (10%) as females (5%) to drink daily.

In 2010, 1 in 5 people aged 14 and over consumed alcohol at a level that put them at risk of harm over their lifetime, and this remained stable between 2007 (20%) and 2010 (20%) (Table 7.5). The number of people drinking at risky levels increased from 3.5 million in 2007 to 3.7 million in 2010; however, the Australian population also grew by about 1.2 million over that time. Males were more likely to drink in risky quantities, and those aged 18–29 were more likely than any other age group to consume alcohol in quantities that placed them at risk of alcohol-related harm over their lifetime (Table 7.5).

Table 7.4: Alcohol drinking status, people aged 14 and over, by sex, 2007 and 2010 (per cent)

Drinking status	Males		Females		Persons	
	2007	2010	2007	2010	2007	2010
Daily	10.8	9.6	5.5	4.9	8.1	7.2
Weekly	46.8	45.2	35.9	33.9	41.3	39.5
Less than weekly	28.3	28.8	38.5	38.7	33.5	33.8
Ex-drinker ^(a)	5.8	6.4	8.1	8.3	7.0	7.4
Never a full glass of alcohol	8.2	10.0	12.1	14.2	10.1	12.1

(a) Consumed at least a full serve of alcohol, but not in the previous 12 months.

Source: AIHW 2011f.





Table 7.5 Alcohol consumption distribution, people aged 12 and over at risk of alcohol-related harm over a lifetime (2009 guidelines), by age and sex, 2007 and 2010 (per cent)

Age group (years)	Abstainers ^(a)		Lifetime risk among alcohol consumers			
			Low risk ^(b)		Risky ^(c)	
	2007	2010	2007	2010	2007	2010
Males						
12–15	70.2	78.7	28.8	20.7	1.0	**0.6
16–17	27.4	30.7	57.3	58.1	15.4	11.2
18–19	9.8	12.5	56.5	45.2	33.7	42.3
20–29	11.1	13.9	50.0	50.0	38.9	36.1
30–39	10.9	13.5	59.8	55.4	29.4	31.1
40–49	10.8	12.5	57.9	56.7	31.2	30.8
50–59	9.9	12.8	59.2	56.4	30.9	30.8
60–69	15.2	13.5	57.6	58.6	27.2	27.9
70+	20.0	21.7	59.5	59.6	20.5	18.7
<i>Total (14+)</i>	<i>14.0</i>	<i>16.4</i>	<i>56.7</i>	<i>54.6</i>	<i>29.2</i>	<i>29.0</i>
Male total	16.5	18.8	55.2	53.1	28.3	28.1
Females						
12–15	69.5	75.6	28.1	22.9	2.4	*1.5
16–17	21.4	32.5	69.9	58.9	8.8	8.6
18–19	12.1	14.9	67.7	64.8	20.2	20.3
20–29	14.8	15.6	67.9	67.0	17.3	17.4
30–39	13.5	17.9	74.4	70.8	12.2	11.3
40–49	13.9	16.0	72.5	71.2	13.6	12.8
50–59	18.1	20.2	70.9	68.0	11.0	11.9
60–69	26.3	26.0	65.5	66.5	8.2	7.5
70+	37.7	37.3	57.9	58.0	4.5	4.7
<i>Total (14+)</i>	<i>20.1</i>	<i>22.5</i>	<i>68.2</i>	<i>66.1</i>	<i>11.7</i>	<i>11.3</i>
Female total	22.1	24.5	66.5	64.4	11.3	11.0
Persons						
<i>Total (14+)</i>	<i>17.1</i>	<i>19.5</i>	<i>62.5</i>	<i>60.4</i>	<i>20.3</i>	<i>20.1</i>
Total	19.4	21.7	60.9	58.8	19.7	19.5

(a) Not consumed alcohol in previous 12 months.

(b) On average, had no more than 2 standard drinks per day.

(c) On average, had more than 2 standard drinks per day.

* Estimate has a relative standard error of 25% to 50% and should be used with caution.

** Estimate has a relative standard error greater than 50% and is considered too unreliable for general use.

Source: AIHW 2011f.





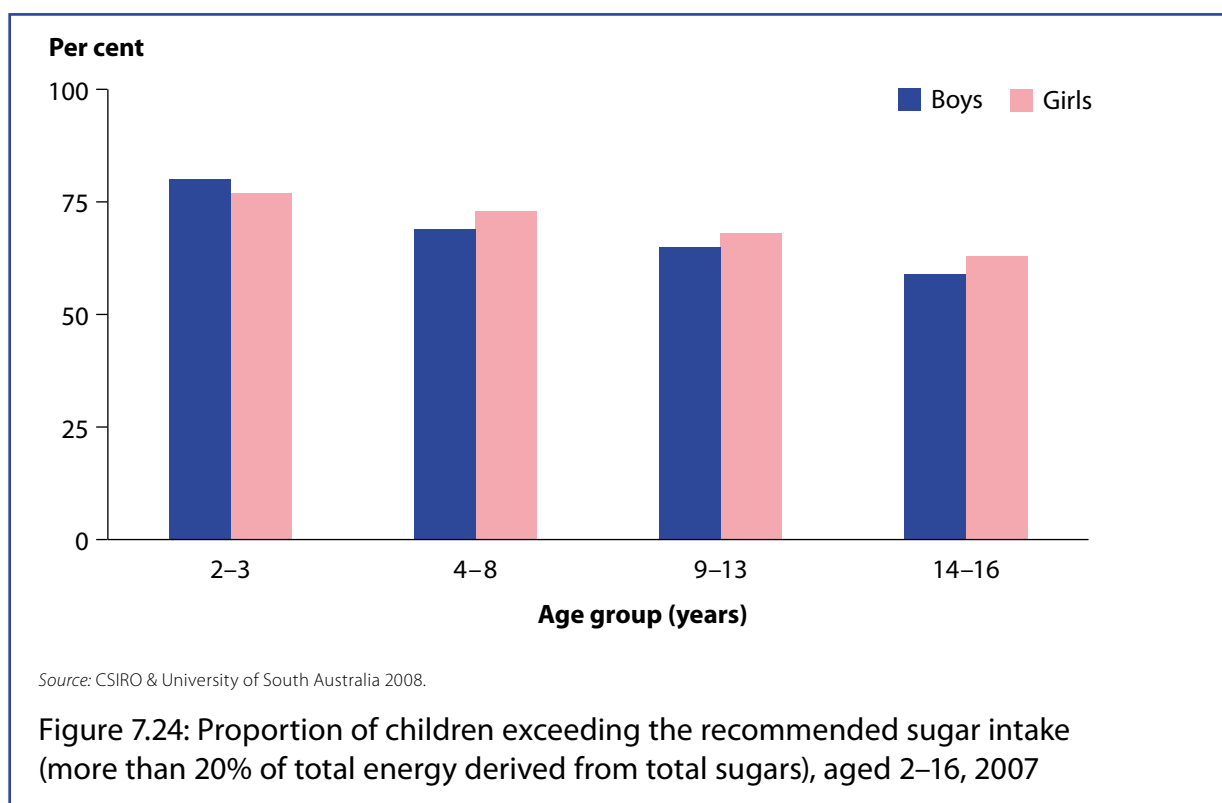
High-fat and/or sugar foods

The Australian Dietary Guidelines advise limiting saturated fat intake and eating only moderate amounts of added sugars to avoid displacing nutrients and increasing the risk of dental caries (NHMRC 2003a).

Foods that are high in energy and low in nutrients are classified as 'extra' foods in the *Australian guide to healthy eating*; that is, they are not a necessary component of the diet to achieve nutrient requirements (Smith et al. 1998). Most foods high in fat and/or sugar predominantly fit into this category.

2007 Children's survey analysis

The Australian Dietary Guidelines indicate that up to 15–20% of energy from sugars is compatible with a healthy diet. However, data from the 2007 Children's survey show that the majority of children had energy intakes from total sugars greater than 20% (Figure 7.24).



1995 NNS analysis

The intake of extra foods among Australians has been assessed using food consumption data from the 1995 NNS (Rangan et al. 2008; Rangan et al. 2009). The *Australian guide to healthy eating* was used to guide the classification of foods as extra, which, at that time, included sweet biscuits, cakes, high fat savoury biscuits, pastries, salami, hamburgers, pizza, fried potatoes, crisps, fat spreads, oils, confectionery, soft drinks, fruit drinks, cordials and alcohol.



For adults aged 19 and over, of the 4,089 foods consumed, 1,288 were classified as extras—and these were eaten by nearly every adult (99%). These foods contributed more than one-third (36%) of energy intake (Table 7.6). Similarly, for children (aged 2–18), of the 2,649 foods consumed, 942 were classified as extras and consumed by nearly every child. These foods contributed more than one-third (41%) of the childrens' energy intakes (Table 7.7).

Among the extra foods consumed in the 1995 NNS, the main contributors to energy intake for adults were fried potatoes, margarine, cakes and muffins, beer, sugar-sweetened soft drinks and meat pies (Table 7.6). For children, the main contributors were fried potatoes, sugar-sweetened soft drinks, ice cream, cordials, meat pies and margarine (Table 7.7).

Table 7.6: Consumption of the 14 extra foods that contribute most to energy intake, people aged 19 and over, 1995

Extra food	Proportion consuming (per cent)	Mean intake (grams/day)	Mean contribution to total energy (per cent)
Fried potatoes	17.3	25.0	2.8
Margarine	53.1	7.8	2.6
Cakes and muffins	18.9	17.8	2.5
Beer	16.6	188.8	2.4
Sugar-sweetened soft drinks	24.0	136.2	2.4
Meat pies/savoury pastries	10.5	21.3	2.2
Sweet biscuits	25.4	9.0	2.0
Sugar	52.4	9.7	1.8
Wine	15.2	52.5	1.7
Ice cream/ice confection	15.3	17.1	1.3
Chocolate/chocolate bars	13.9	5.9	1.2
Sweet pies/pastries	7.7	10.7	1.2
Butter and dairy fats	22.8	3.5	1.1
Pizza	4.7	10.4	1.0
All extra foods	99.1	700.1	35.9

Note: Consumption data are for the survey day.

Source: Rangan et al. 2009.





Table 7.7: Consumption of the 12 extra foods that contribute most to energy intake, children and adolescents aged 2–18, 1995

Extra food	Proportion consuming (per cent)	Mean intake (grams/day)	Mean contribution to total energy (per cent)
Fried potatoes	25.0	36.3	4.2
Sugar-sweetened soft drinks	35.4	180.7	3.3
Ice cream/ice confection	30.0	41.3	3.1
Cordials	35.4	119.3	2.7
Meat pies/savoury pastries	12.7	22.6	2.6
Margarine	61.8	7.3	2.5
Sweet biscuits	31.1	10.4	2.4
Cakes/muffins	17.3	15.8	2.3
Chocolate/chocolate bars	26.8	10.6	2.2
Potato crisps	17.5	6.0	1.5
Fruit drinks	18.9	71.8	1.4
Pizza	7.4	11.6	1.3
All extra foods	99.8	725.3	40.9

Note: Consumption data are for the survey day.

Source: Rangan et al. 2008.

7.5 Nutrient intakes

Nutrients are generally grouped into two separate categories: macronutrients and micronutrients. Macronutrients are sources of energy, whereas micronutrients generally provide no energy, are needed in only minute amounts, and cannot be synthesised from simpler components.

Adequacy of nutrient intake is assessed using the relevant Nutrient Reference Values (NRVs) for adequacy developed by the NHMRC and New Zealand Ministry of Health (NHMRC & NZMoH 2006). Definitions for selected NRVs are in Box 7.5. This publication outlines the recommended intake levels for a number of selected nutrients (including essential vitamins and minerals, macronutrients and some non-essential substances) for males and females of all ages and stages of the life cycle in Australia and New Zealand. The relevant NRVs can be used by health professionals to assess the likelihood of inadequate intake in individuals or groups of people (NHMRC & NZMoH 2006).





Box 7.5: Definitions of selected Nutrient Reference Values

Estimated Average Requirement (EAR)

The daily nutrient intake estimated to meet the requirements of half the healthy individuals in a particular life stage and gender group. The EAR is used to estimate the prevalence of inadequate intakes within a group. However, it is not appropriate to use the EAR for iron, which has a non-normal requirement distribution.

Recommended Dietary Intake (RDI)

The average daily dietary intake level that is sufficient to meet the nutrient requirements of nearly all (97–98%) healthy individuals in a particular life stage and gender group. RDIs are used to plan diets or assess if an individual's dietary intake is likely to be adequate. It is not used to assess the intake of groups.

Adequate Intake (AI) (used when an RDI cannot be determined)

The average daily nutrient intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate. Mean usual intake at or above this level implies a low prevalence of inadequate intakes. When the AI is based on median intakes of healthy populations, this assessment is made with less confidence.

Upper Level of Intake (UL)

The highest average daily nutrient intake likely to pose no adverse health effects to almost all individuals in the general population. As intake increases above the UL, the potential risk of adverse effects increases. The UL is used to estimate the percentage of the population at potential risk of adverse effects from excessive nutrient intake.

Acceptable Macronutrient Distribution Range (AMDR)

The AMDR is an estimate of the range of intake for each macronutrient for individuals (expressed as per cent contribution to energy) that would allow for an adequate intake of all the other nutrients while maximising health outcome.

Source: NHMRC & NZMoH 2006.

Where possible, the proportion of the population with inadequate intakes has been estimated by calculating the proportion with intakes less than the relevant EAR. For micronutrients where there are no EAR values, but AI values instead, dietary intakes below the AI may indicate inadequate intake at the population level. Macronutrient intakes have been compared with the AMDR.





Macronutrients

2007 Children's survey analysis

The mean intake of macronutrients for children aged 2–16 is shown in Table 7.8. Further analysis of macronutrient intakes is in subsequent sections.

Table 7.8: Mean intake^(a) of energy, macronutrients and total moisture, children aged 2–16, 2007

Component	Unit	Age group (years)			
		2–3	4–8	9–13	14–16
Energy	(kJ)	6,038.1	7,245.0	8,922.4	10,056.6
Energy—including fermentable fibre	(kJ)	6,167.0	7,394.1	9,101.4	10,253.5
Moisture ^(b)	(L)	1.5	1.7	2.2	2.5
Protein	(g)	60.0	70.0	87.5	101.9
Total fat ^(c)	(g)	51.0	61.8	75.8	86.7
Saturated fat	(g)	23.9	28.0	33.9	38.1
Monounsaturated fat	(g)	17.1	21.4	26.6	30.9
Polyunsaturated fat	(g)	6.2	7.9	9.8	11.4
Cholesterol	(mg)	167.3	201.5	245.1	280.8
Total carbohydrate ^(d)	(g)	188.2	226.6	278.5	307.1
Total sugars	(g)	98.8	111.5	135.4	145.2
Total starch	(g)	87.6	113.0	140.3	158.7
Alcohol ^(e)	(g)	0.0	0.0	0.0	0.2
Fibre	(g)	16.1	18.6	22.3	24.6

(a) One-day nutrient intake data from food and beverages only (no supplements) collected at CAPI, population weights applied.

(b) Includes plain drinking water and fluids derived from food and beverages.

(c) The sum of the three fatty acid (saturated, monounsaturated and polyunsaturated) subtotals is less than the total fat value due to the contribution of the non-fatty acid and components in the triglyceride unit such as the glycerol backbone, possible phosphate groups and sterols.

(d) For some foods, data for total carbohydrate include a contribution from glycogen, sugar alcohols and oligosaccharides where the levels of these carbohydrates are known. For these foods, the sum of the total sugars and starch will not equal the total carbohydrate value.

(e) Represents pure alcohol.

Source: CSIRO & University of South Australia 2008.





1995 NNS analysis

The mean intake of macronutrients for the people aged 16 and over is in Table 7.9, with further analysis in subsequent sections.

Table 7.9: Mean intake of energy, macronutrients and total moisture by age group, NNS, 1995

Component	Unit	Age group (years)				
		16–18	19–24	24–44	45–64	65+
Energy	(kJ)	11,175.0	10,871.6	9,799.3	8,778.2	7,298.6
Moisture ^(a)	(L)	2.8	3.1	3.2	3.2	2.7
Protein	(g)	100.7	103.6	95.7	89.7	72.7
Total fat ^(b)	(g)	98.6	97.7	88.8	77.7	64.3
Saturated fat	(g)	41.9	39.6	35.5	30.1	25.0
Monounsaturated fat	(g)	35.2	35.5	32.4	28.5	23.2
Polyunsaturated fat	(g)	13.5	14.5	13.2	12.0	10.0
Cholesterol	(mg)	319.9	332.5	312.7	296.0	235.5
Total carbohydrate	(g)	338.5	311.0	268.6	237.5	205.2
Total sugars	(g)	173.4	147.4	118.6	105.5	96.4
Total starch	(g)	163.8	162.4	148.4	130.2	107.0
Alcohol ^(c)	(g)	6.6	11.0	14.0	14.2	9.0
Fibre	(g)	23.0	22.3	23.1	23.9	21.8

(a) Includes plain drinking water and fluids derived from food and beverages.

(b) The sum of three fatty acid (saturated, monounsaturated and polyunsaturated) sub-totals is less than the total fat value due to the contribution of non-fatty acids and components in the triglyceride unit such as the glycerol backbone, possible phosphate groups and sterols.

(c) Represents pure alcohol.

Note: One-day nutrient intake data collection, adjusted for within-person variability, with population weights applied.

Source: 1995 NNS (ABS 1998).

Energy

2007 Children's survey analysis

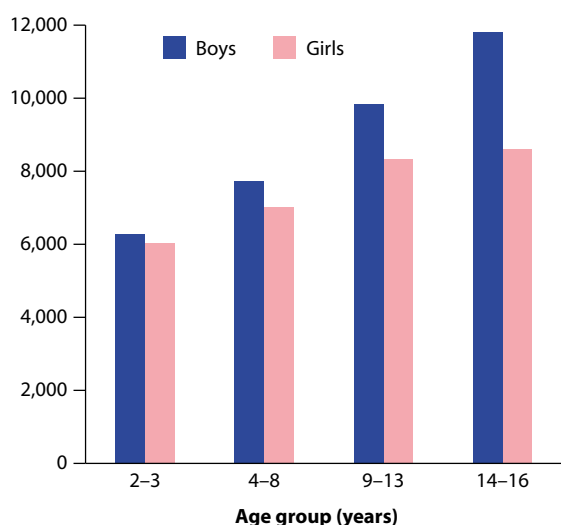
In the 2007 Children's survey, energy intake was calculated using two different equations; one was the same as that used in the 1995 NNS, and the other acknowledged the contribution from dietary fibre (8 kilojoules per gram). For comparison purposes, the same equation that was used in the 1995 NNS has been used to derive Figure 7.25.

Energy intakes in children increased with age. Compared with girls, boys had higher intakes and this difference became more marked in older age groups. Boys aged 14–16 had the highest energy intake at 11,598 kilojoules per day compared with 8,436 kilojoules per day for girls of the same age. The contribution to total energy intake from total carbohydrate, total fat and protein was relatively similar for all age groups (Figure 7.26). In general, boys have higher body weights and energy requirements and consequently eat more food than girls.





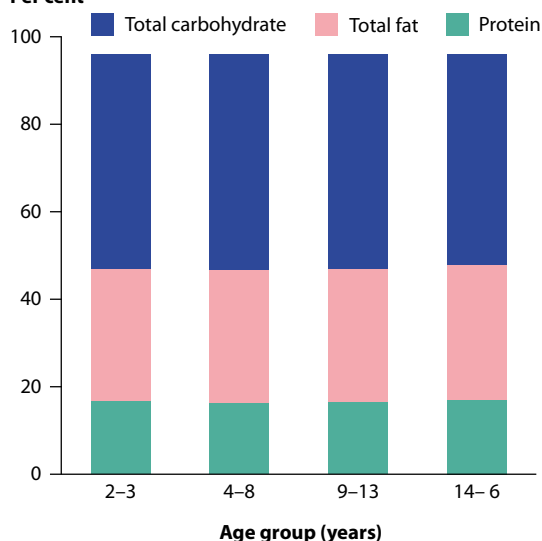
Energy intake (kilojoules)



Source: CSIRO & University of South Australia 2008.

Figure 7.25: Mean one-day energy intake, children aged 2–16, 2007

Per cent



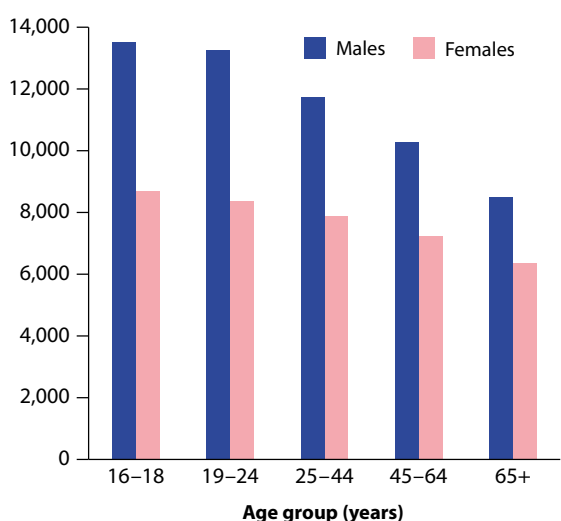
Source: CSIRO & University of South Australia 2008.

Figure 7.26: Mean percentage contribution of macronutrients to energy intake, children aged 2–16, 2007

1995 NNS analysis

Males had higher energy intakes across all age groups than females (Figure 7.27). Mean energy intakes were highest for males and females aged 16–18 (13,526 kilojoules and 8,691 kilojoules respectively) and gradually declined with age. The contribution to total energy intake from total carbohydrate, total fat and protein was relatively similar for all age groups, with carbohydrate providing about half (45–50%), fats about one-third (32–33%) and protein 16–18% of energy. The contribution of alcohol to energy intake increased gradually from 1.3% in 16–18 year olds to a maximum of 4.3% in 45–64 year olds (Figure 7.28).

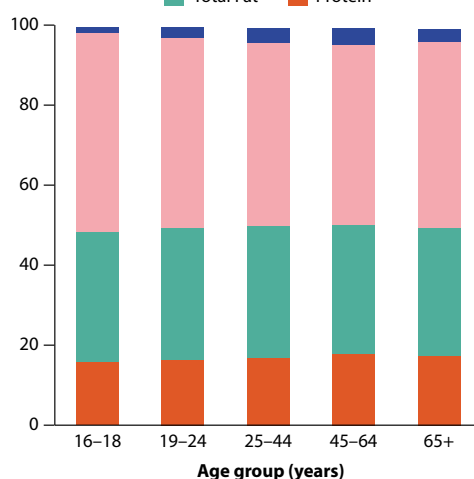
Energy intake (kilojoules)



Source: 1995 NNS (ABS 1998).

Figure 7.27: Mean one-day energy intake for males and females, aged 16 and over, 1995

Per cent



Source: 1995 NNS (ABS 1998).

Figure 7.28: Mean percentage contribution of macronutrients to energy intake, aged 16 and over, 1995



Moisture

Moisture intake includes water obtained from both foods and beverages, but excludes that which results from energy production in the body. Adequate moisture consumption is important for good health. Water is defined as an essential nutrient because it is required in amounts that exceed the body's ability to produce it. Water is also required for digestion, absorption, transportation, dissolving nutrients, elimination of waste products and thermoregulation (NHMRC & NZMoH 2006).

2007 Children's survey analysis

Mean moisture intakes from both beverages and foods ranged from about 1.5 litres per day for children aged 2–3, up to about 2.5 litres per day for older children (aged 14–16) (Table 7.8). For all age groups, mean moisture intakes met or were above the AI for water (Table 7.10).

Table 7.10: Mean daily intakes and Adequate Intakes for water (food and beverages), by age and sex

	Age group (years)	Mean intake (litres)	AI (litres)
Children and adolescents			
All	2–3	1.5	1.4 ^(a)
	4–8	1.7	1.6
Boys	9–13	2.3	2.2
	14–16	2.7	2.7 ^(b)
Girls	9–13	2.0	1.9
	14–16	2.2	2.2 ^(b)
Adults			
Men	19+	3.4	3.4
Women	19+	2.8	2.8

(a) AI for children aged 1–3.

(b) AI for ages 14–18.

Note: Mean intake for children and adolescents from 2007 Children's Survey; mean intake for adults from 1995 NNS.

Source: CSIRO & University of South Australia 2008; ABS 1998; NHMRC & NZMoH 2006.

1995 NNS analysis

Mean moisture intakes from both beverages and foods in adults met the AI for all age groups, except those aged 65 and over (Table 7.9).

Protein

The NRVs for protein are expressed in two different ways that reflect both the need for protein to maintain muscle mass and other protein-based structures in the body, and in children, for appropriate growth and development.

The second recommendation expresses protein as a proportion of total energy. The AMDR for protein is 15–25% of energy. Protein intakes of at least 15% of energy appear to be required by most people to ensure the EARs for micronutrients are met. A prudent upper level of 25% energy from protein has also been set (NHMRC & NZMoH 2006).





2007 Children's survey analysis

Mean protein intakes in the population aged 2–16 ranged from 60 to 102 grams per day (Table 7.8). Compared with the EARs for protein, mean protein intakes met the recommended levels for all age groups (Table 7.11). Mean dietary protein contributed 16–18% of total energy (CSIRO & University of South Australia 2008).

Table 7.11: People consuming less than the EAR for protein (per cent), by age and sex

	Age group (years)	EAR		Percentage with intake less than EAR
		(grams/ day)	(grams/ kilogram)	
Children and adolescents				
All	1–3	12	0.92	0 ^(a)
	4–8	16	0.73	0
Boys	9–13	31	0.78	0
	14–18	49	0.76	0 ^(b)
Girls	9–13	24	0.61	0
	14–18	35	0.62	0 ^(b)
Adults				
Men	19–30	52	0.68	0
	31–50	52	0.68	0
	51–70	52	0.68	0
	>70	65	0.86	25
Women	19–30	37	0.60	0
	31–50	37	0.60	0
	51–70	37	0.60	0
	>70	46	0.75	10

(a) Value for children aged 2–3.

(b) Value for children aged 14–16.

Note: Children and adolescent data from 2007 Children's Survey; Adult data from 1995 NNS.

Source: CSIRO & University of South Australia 2008; ABS 1998; NHMRC & NZMoH 2006.

1995 NNS analysis

Mean protein intakes in the population aged 16 and over ranged from 73 to 104 grams per day (Table 7.9). Compared with the EAR for protein, mean intakes met the recommended levels for all age groups, except for people aged 65 and over, where about 25% of men and about 10% of women did not (Table 7.11). Mean dietary protein contributed 16–18% of total energy (ABS 1998).





Fat

Fat is the most concentrated form of energy and is needed for the absorption of fat-soluble vitamins and as a source of essential fatty acids. The main types of fat found in food are described in Box 7.6.

A range of 20–35% of energy from fat is recommended for the general population to provide a suitable intake of fats and reduce chronic disease risk (NHMRC & NZMoH 2006). It is also recommended that saturated and *trans* fatty acids combined should be no more than 10% of total energy (NHMRC & NZMoH 2006). In addition, the WHO has recommended that *trans* fatty acids should be no more than 1% of total dietary energy (WHO 2003).

Box 7.6: Types of fat

The main types of fat found in food are saturated, polyunsaturated and monounsaturated fats.

Saturated fats contribute to the risk of heart disease by raising blood cholesterol levels. They are commonly found in many deep-fried takeaway foods, in commercial products such as biscuits, and pastries and fatty meats.

Monounsaturated fats help lower blood cholesterol and reduce the risk of heart disease. They are found in lean meats, oils such as canola and olive, and other plant foods, including avocados, nuts and seeds.

Polyunsaturated fats can help lower blood cholesterol and reduce the risk of heart disease. They are commonly found in plant foods, including sunflower, safflower and soybean oils, nuts and seeds. These fats are also found in oily fish such as salmon, tuna and sardines.

Omega-3 and **Omega-6** fats are types of polyunsaturated fats. Omega-3 fats are mainly found in oily fish and Omega-6 fats are mainly found in vegetable oils.

Trans fatty acids are another type of fat which increase the risk of heart disease at least as much as saturated fat. They occur naturally in small amounts in dairy foods and meat and in some processed vegetable oils (hydrogenated vegetable oils). The main sources of *trans* fatty acids are manufactured foods that use hydrogenated vegetable fats, such as baked products (for example, pies, pastries, cakes, biscuits, buns), some commercially deep fried foods and hard margarines. While *trans* fatty acids are chemically unsaturated fats, physiologically, they behave more like saturated fat and are generally considered in conjunction with these fats.

Other dietary fats include phospholipids, phytosterols and cholesterol.

Cholesterol is a fatty substance that is produced naturally by the body and also obtained from eating animal products. High blood cholesterol can be caused by eating too much saturated fat.

Source: Better Health Channel 2012.

2007 Children's survey analysis

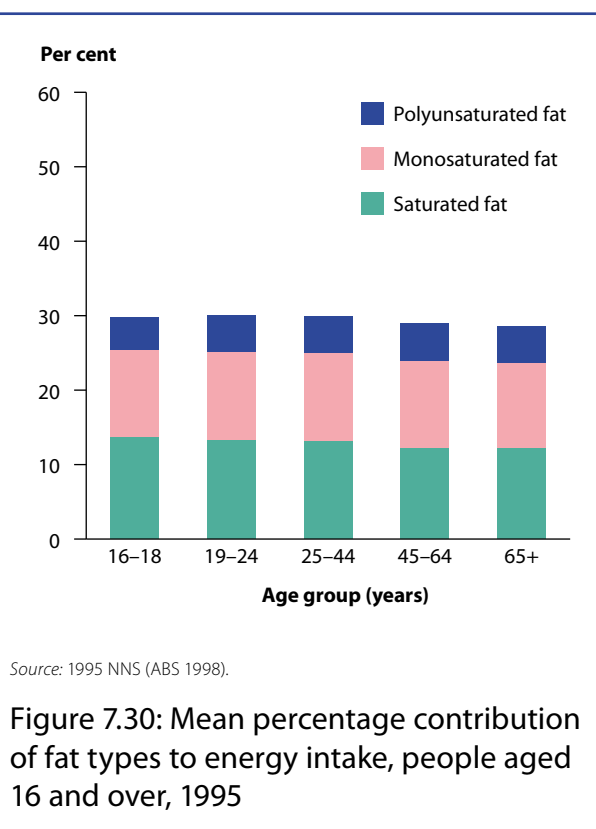
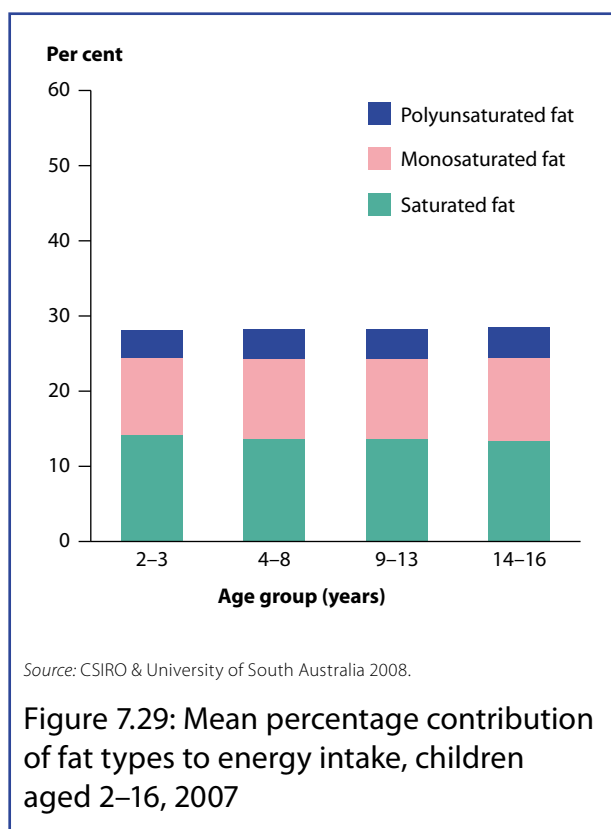
In the Children's survey, total dietary fat contributed just under one-third of total energy intake (30–31%), with saturated fat contributing more to total energy (13–14%) than monounsaturated (10–11%) and polyunsaturated fat (4%) (Figure 7.29). Mean total fat intakes were within the AMDR of 20–35%. However, saturated fat intake, as a percentage of total energy, was higher than the 10% maximum recommended (NHMRC & NZMoH 2006), even without the inclusion of *trans* fat intakes.





1995 NNS analysis

In the 1995 NNS, total dietary fat contributed 32–33% of energy in the population aged 16 and over, which is within the AMDR of 20–35%. However, the mean saturated fat intake, as a percentage of total energy, was higher than the maximum of 10% recommended for saturated fat and *trans* fatty acids combined, even without the inclusion of *trans* fat intake. Mean saturated fat intakes gradually decreased with age, with 16–18 year olds having the highest (14%) and people aged 45 and over the lowest (12%). Saturated fat contributed more to total energy (12–14%) than monounsaturated (11–12%) and polyunsaturated fat (5.0%) (Figure 7.30).



Trans fat analysis

Estimates of *trans* fats were not reported in the 2007 Children's survey or the 1995 NNS (ABS 1998; CSIRO & University of South Australia 2008) and so are not estimated separately in the above analyses.

In 2009, FSANZ undertook a review of *trans* fats using data from the 1995 NNS and the 2007 Children's survey (FSANZ 2009a) and revised its food composition database. The review found that the mean contribution of *trans* fats to total energy intake was 0.5% for people aged 17 and over, which was less than the maximum recommendation of no more than 1% (Table 7.12). However, the combined contribution of saturated fat plus *trans* fats (14%) was 1.4 times the maximum AMDR of 10%.

Similar results were found with children aged 2–16, where the mean contribution of *trans* fats to total energy (0.5%) was half the recommendation, while the contribution of saturated fat plus *trans* fats (14%) was 1.4 times higher than the maximum recommended.





Table 7.12: *Trans* fat and saturated plus *trans* fat intakes as a percentage of energy intake^(a), Australia

Survey	Age groups	Energy intake mean (kJ)	Percentage of energy intake	
			Total <i>trans</i> fat intake	Saturated + <i>trans</i> fat intake
2007 Children's Survey	2–16 years	8,150	0.6	14.0
1995 NNS	17 years and over	9,080	0.5	14.0

(a) Using post-2007 concentration data of fats.

Source: FSANZ 2009b.

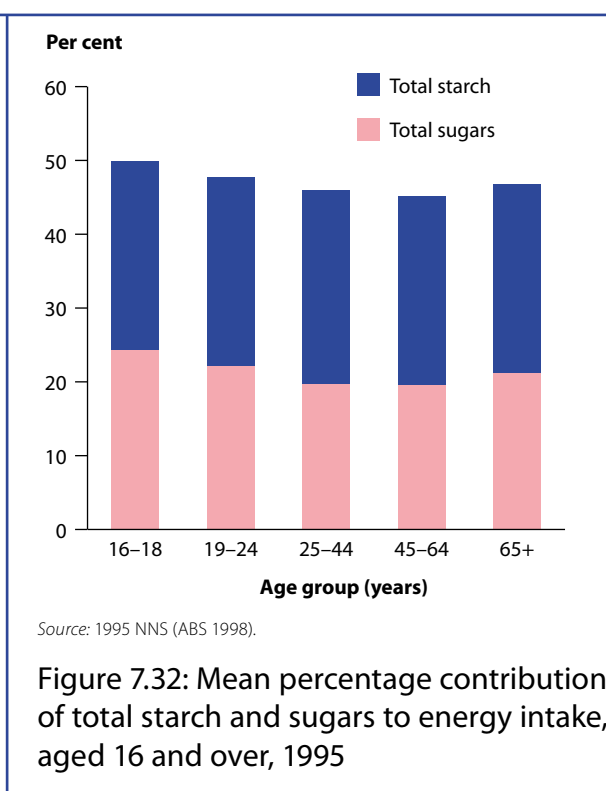
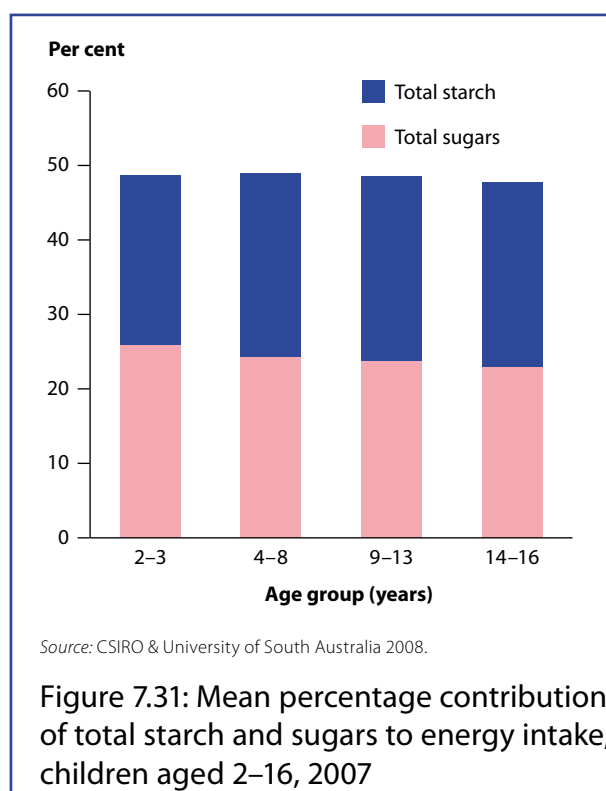
Carbohydrate

Carbohydrates are the body's preferred source of energy, although other nutrients, such as fat, protein and alcohol, also provide energy. The recommended intake range for carbohydrate is 45–65% of energy (NHMRC & NZMoH 2006).

2007 Children's survey analysis

In the Children's survey, carbohydrates contributed just under half of the total energy for all age groups (48–49%). Mean total carbohydrate intakes were within the AMDR.

Of the carbohydrates consumed, starch and sugars contributed to total energy intake in differing amounts. In the younger age group (aged 2–3), more energy came from sugars (26%) than starch (23%) which reflects their higher milk consumption; however, this order was reversed for older children, with those aged 14–16 consuming more energy from starch (25%) than sugars (23%) (Figure 7.31).



1995 NNS analysis

In the 1995 NNS, carbohydrates contributed the largest proportion of energy intake—between 45% and 50% in people aged 16 and over. Mean total carbohydrate intakes were within the AMDR.

Of the carbohydrates consumed, the contribution of total sugars to energy intake generally decreased with age, from 24% for 16–18 year olds to 20% for 45–64 year olds. In contrast, the contribution of starch to energy intake was relatively constant (about 26%) across all age groups (Figure 7.32).



Fibre

Dietary fibre describes plant food components that pass through the stomach and small intestine undigested and reach the large intestine (colon) basically unchanged. Adequate fibre intakes are important for the efficient functioning of the gut and to reduce the risk of certain chronic diseases, such as heart disease, diabetes and some cancers (NHMRC & NZMoH 2006). However, it is not possible to compare fibre intakes from national surveys to the AI for fibre. Although the fibre is derived from the mean intake in 1995, an additional amount was added to allow for the fibre that was not detected via the laboratory methods used to develop the food composition tables. Therefore, the mean intake in the 1995 survey will appear to be lower than the AI, by definition.

Micronutrients

2007 Children's survey analysis

In general, children's micronutrient intakes increase with age, largely as a result of increasing quantities of food being consumed (Table 7.13). Of the nutrients assessed, the majority of children in all age and sex groups met the EARs, with the exception of calcium. The proportion of children meeting the EAR for calcium decreased with age and was only 11% for girls aged 12–13 (Figure 7.33). This is likely to reflect dairy food intake for older girls not rising to match increased requirements with ageing (see Figure 7.21). Magnesium intakes for girls also decreased with age, with 66% of girls aged 14–16 not meeting the EAR. All children met the recommended intake for sodium, and mean intakes greatly exceeded upper levels of intake.

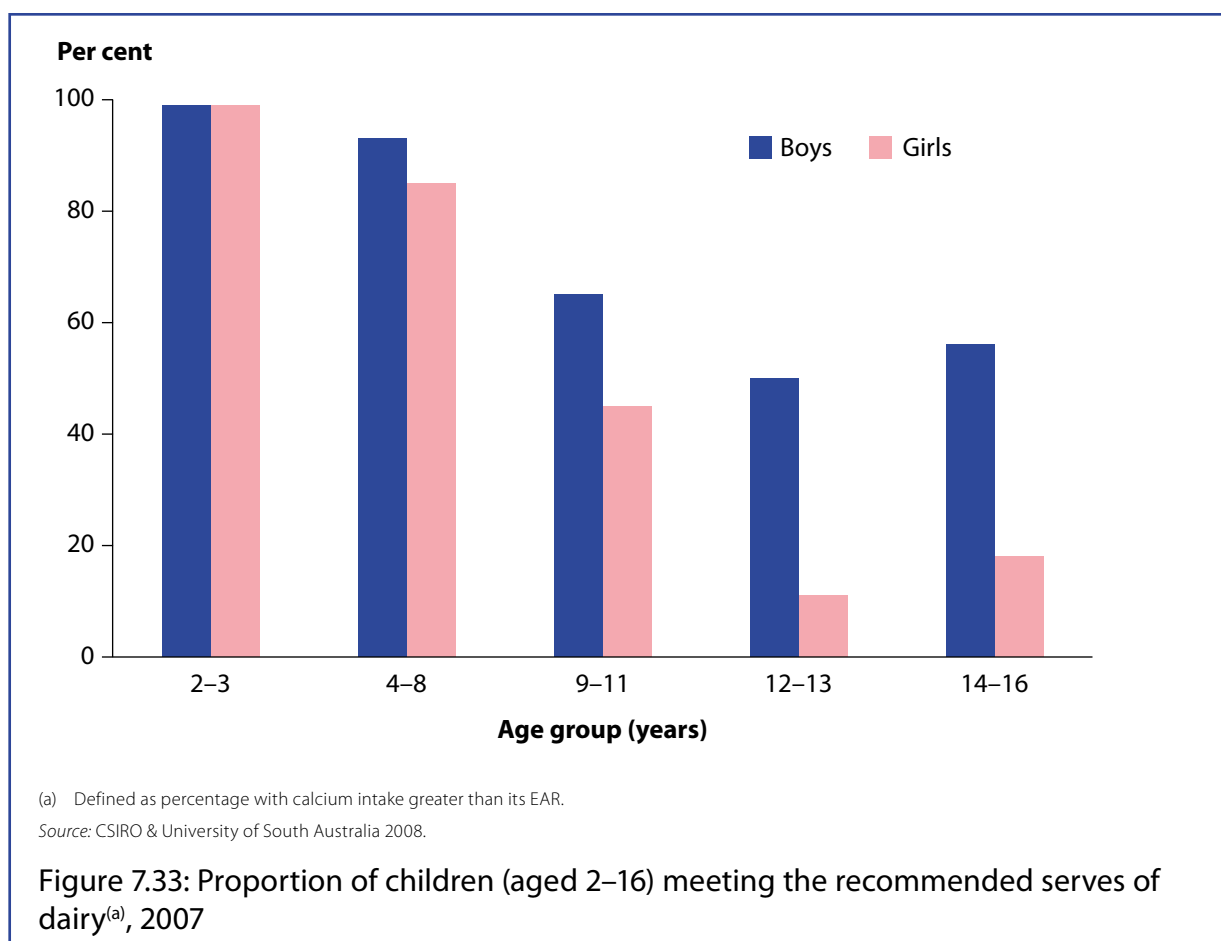




Table 7.13: Mean intake^(a) and NRVs^(b) of selected micronutrients, children aged 2–16, 2007

Micronutrient	Unit		Age group (years)							
			2–3		4–8		9–13		14–16	
			Male	Female	Male	Female	Male	Female	Male	Female
Vitamin A (retinol equivalents)	(µg)	EAR	210	210	275	275	445	420	630	485
		Mean intake	692	622	693	685	781	711	929	744
Thiamin	(mg)	EAR	0.4	0.4	0.5	0.5	0.7	0.7	1.0	0.9
		Mean intake	1.5	1.4	1.7	1.6	2.1	1.7	2.5	1.7
Riboflavin	(mg)	EAR	0.4	0.4	0.5	0.5	0.8	0.8	1.1	0.9
		Mean intake	2.4	2.3	2.4	2.2	2.8	2.2	3.3	2.3
Niacin equivalents	(mg)	EAR	5	5	6	6	9	9	12	11
		Mean intake	33	32	40	35	50	41	63	42
Folate equivalents	(µg)	EAR	120	120	160	160	250	250	330	330
		Mean intake	442	420	472	436	519	443	579	441
Vitamin C	(mg)	EAR	25	25	25	25	28	28	28	28
		Mean intake	88	80	103	90	121	113	150	129
Vitamin D	(mg)	EAR	5	5	5	5	5	5	5	5
		Mean intake	3.3	3.1	3.0	2.7	3.4	2.7	4.0	2.8
Vitamin E	(mg)	AI	5	5	6	6	9	8	10	8
		Mean intake	4.2	4.3	5.2	5.1	6.7	6.1	8.3	6.7
Calcium	(mg)	EAR	360	360	520	520	^(c) 800, 1,050	^(c) 800, 1,050	1,050	1,050
		Mean intake	830	780	842	747	989	792	1,143	826
Phosphorus	(mg)	EAR	380	380	405	405	1,055	1,055	1,055	1,055
		Mean intake	1,136	1,097	1,284	1,158	1,581	1,333	1,917	1,380
Magnesium	(mg)	EAR	65	65	110	110	200	200	340	300
		Mean intake	231	222	263	239	332	278	385	296
Zinc	(mg)	EAR	2.5	2.5	3	3	5	5	11	6
		Mean intake	8.0	7.6	9.7	8.3	12.0	9.9	15.3	10.0
Potassium	(mg)	AI	2,000	2,000	2,300	2,300	3,000	2,500	3,600	2,600
		Mean intake	2,283	2,196	2,498	2,284	3,127	2,656	3,696	2,822
Iodine	(µg)	EAR	65	65	65	65	75	75	95	95
		Mean intake	128	123	125	112	153	121	175	119
Sodium	(mg)	AI	200–400	200–400	300–600	300–600	400–800	400–800	460–920	460–920
		Mean intake	1,691	1,658	2,229	2,090	2,890	2,490	3,672	2,624

(a) One-day nutrient intake data from food and beverages only (no supplements) collected at CAPI. Population weights applied.

(b) EARs are provided for all micronutrients except vitamin E, potassium and sodium, for which AIs are provided.

(c) 800 mg is EAR for children aged 9–11; 1,050 mg is EAR for children aged 12–13.

Source: CSIRO & University of South Australia 2008.





1995 NNS analysis

Mean micronutrient intakes for the population aged 16 and over are in Table 7.15. Of the nutrients assessed, with the exception of calcium, the majority of the population met the EARs. Females were more likely than males to have inadequate calcium intakes. Calcium benefits bone and dental health, and low intakes have been associated with osteoporosis (loss of bone density that often results in bone fractures) (NHMRC & NZMoH 2006).

The main dietary sources are dairy foods, particularly milk and cheese. Other sources include bony fish, legumes and certain nuts, calcium-fortified breakfast cereals, soy milk, fruit juices, and minor sources such as calcium salts used as food additives (ABS 1999).

A 2008 analysis by FSANZ that used 1995 NNS data showed that the majority of males and females in Australia, most notably adolescent girls and older men and women, have inadequate calcium intakes (Table 7.14) (FSANZ 2008f).

Table 7.14: Estimated current mean calcium intakes^(a) and proportion of the population below the EAR^{(b)(c)}, 1995

Age group (years)	Males		Females	
	Mean intake (milligrams)	Percentage with intake less than EAR	Mean intake (milligrams)	Percentage with intake less than EAR
2–3	932	0	807	0
4–8	901	4	759	10
9–13	1,018	45	802	65
14–18	1,180	45	789	80
19–29	1,136	30	797	65
30–49	952	45	744	70
50–69	861	55	721	90
70+	779	90	679	95

(a) Current mean intakes are based on a market share model. Mean calcium intakes are determined by weighting the concentration of calcium in foods according to the proportion of a food group that is fortified. The estimates have been adjusted based on a second day's intake.

(b) Percentages above 10% have been rounded to the nearest 5%.

(c) The proportion of the population with intakes currently below the EAR has been used to estimate inadequate calcium intake in the population.

Source: FSANZ analysis of the 1995 Australian National Nutrition Survey (FSANZ 2008f).

The 1995 NNS estimates of folate intake were based on the natural folate content of food and did not include additional folic acid from fortified foods. In 2006, new units called dietary folate equivalents (DFE) to calculate folate intake were released (NHMRC & NZMoH 2006) (see Box 7.7). In the 2007 Children's survey, folate was expressed as dietary folate equivalents and the differences in bioavailability between natural folate and folic acid were recognised. Since 1995, many more folic acid-fortified products have appeared on the market and so the folate estimate in Table 7.15 is likely to be an underestimate of current intakes.

Mandatory fortification of flour for bread-making was introduced in 2009 and is estimated to have increased mean folic acid intake by about 110 micrograms or about 150 micrograms DFE across the population aged 2 and over (AIHW 2011g).





Box 7.7: Dietary folate equivalents

DfEs are estimated from both folates found naturally in foods and from added folic acid. DfEs take account of the lower availability of mixed folates in food compared with folic acid used in fortified food or in supplements.

1 µg dietary folate equivalent = 1 µg food folate
 = 0.5 µg folic acid on an empty stomach
 = 0.6 µg folic acid with meals or as fortified foods

Source: NHMRC & NZMoH 2006.

Table 7.15: Mean intake and NRVs^(a) of selected micronutrients, persons aged 16 and over, 1995

Micronutrient	Unit		Age group (years)									
			16–18		19–24		25–44		45–64		65+	
			Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Vitamin A (retinol equivalents)	(µg)	EAR	630	485	625	500	625	500	625	500	625	500
		Mean intake	1,186	877	1,233	889	1,306	1,145	1,360	1,145	1,301	1,059
Thiamin	(mg)	EAR	1.0	0.9	1.0	0.9	1.0	0.9	1.0	0.9	1.0	0.9
		Mean intake	2.3	1.5	2.3	1.5	2.1	1.4	1.8	1.3	1.6	1.2
Riboflavin	(mg)	EAR	1.1	0.9	1.1	0.9	1.1	0.9	1.1	0.9	1.1	0.9
		Mean intake	3.0	1.8	2.7	1.9	2.5	1.8	2.2	1.8	2.0	1.6
Niacin equivalents	(mg)	EAR	12	11	12	11	12	11	12	11	12	11
		Mean intake	54	35	58	36	54	35	49	35	39	29
Folate	(µg)	EAR	330	330	320	320	320	320	320	320	320	320
		Mean intake	313	217	322	233	311	227	309	247	277	225
Vitamin C	(mg)	EAR	28	28	30	30	30	30	30	30	30	30
		Mean intake	154	127	150	120	133	109	138	118	127	112
Calcium	(mg)	EAR	1,050	1,050	840	840	840	840	840	840	840	1,100
		Mean intake	1,280	801	1,101	750	989	762	885	769	796	686
Phosphorus	(mg)	EAR	1,055	1,055	580	580	580	580	580	580	580	580
		Mean intake	2,066	1,337	2,052	1,332	1,867	1,300	1,692	1,295	1,419	1,132
Magnesium	(mg)	EAR	340	300	330	255	330, (b)350	255, (b)265	350	265	350	265
		Mean intake	380	257	390	273	393	284	383	297	334	268
Zinc	(mg)	EAR	11	6	12	6.5	12	6.5	12	6.5	12	6.5
		Mean intake	14.8	10.0	17.3	10.2	14.9	9.9	14.0	9.8	11.4	9.0
Potassium	(mg)	AI	3,600	2,600	3,800	2,800	3,800	2,800	3,800	2,800	3,800	2,800
		Mean intake	4,065	2,674	3,943	2,752	3,818	2,816	3,733	2,930	3,232	2,626

(a) EARs are provided for all micronutrients except potassium, for which AI is provided.

(b) Refers to persons aged 31–44.

(c) Refers to women aged 51–64.

(d) Refers to persons over 70.

Source: 1995 NNS (ABS 1998)





7.6 Comparisons between nutrition surveys

Direct comparison between national surveys is affected by methodological differences affecting national nutrition monitoring. Cook and colleagues (2001a) undertook a bridging study to identify and quantify the impact of differences between the 1983, 1985 and 1995 national surveys on estimated food and nutrient intake. The key characteristics of the three surveys are in Table 7.16. They highlight that the major differences arise from:

- differences in sampling and demographics, including sample frame, survey scope and coverage, collection period, survey days, non-response
- differences in the collection of dietary estimates, the approach to food classification and coding, and changes in the nutrient composition database.

The resultant report provides guidelines for appropriate comparison and interpretation of results. A publication was subsequently produced that presented comparable data from the three surveys (Cook et al. 2001b). This research underpins a potential national nutrition monitoring system.

Comparison between the 1995 NNS survey data for children and the 2007 survey

An equivalent bridging study has not been undertaken for the children's component of the 1995 NNS and the 2007 Children's survey. There are some important differences. The NNS used a probability sampling method, whereas the 2007 survey used a quota sampling method to generate the survey participants. In addition, the 2007 survey was conducted between February and August, whereas the 1995 NNS covered the whole year. Interpretation of the results of these surveys and comparisons between them is further complicated by the extent of non-participation and response bias due to inaccurate or incomplete responses (Cook et al. 2001a). These limitations have not been taken into account in this chapter.

Comparison between the 1983 and 1995 surveys

While it is necessary to have more than two data points to identify a genuine trend, comparing differences between two national surveys can highlight potential changes in eating patterns. Comparable data from the 1983 and 1995 surveys in which the analysis has been undertaken for the population aged 25–64 living in capital cities are in Table 7.17.

For both men and women, the quantities of cereals and cereal products, fish and seafood products, non-alcoholic beverages and legumes consumed increased significantly over this period, whereas consumption of fruit products and dishes, and sugar products and dishes, decreased significantly. Additionally, men's mean intake of alcoholic beverages decreased significantly over this time, as did women's mean intake of meat, poultry and game products.

Comparison between the 1985 and 1995 surveys

Comparable data from the 1985 and 1995 surveys in which the analysis has been undertaken for the population aged 10–15 are in Table 7.18.

For both boys and girls, the quantities of fish and seafood products, non-alcoholic beverages and sugar products and dishes consumed increased significantly. For boys, intake of milk products and dishes decreased significantly over this period.





Table 7.16: Key characteristics of the 1983, 1985 and 1995 nutrition surveys

Survey aspect	1983	1985	1995
Sample size (number)	6,255	5,224	13,858 (day 1), 1,490 (day 2)
Response rate (per cent)	75.3	65.5	61.4 (day 1), 75.4 (day 2)
Survey design	Multistage quota sample from a list	Two-stage list sample	Multistage area sample
Sampling unit and geographical coverage	Electoral enrollees in six state capital cities within a 16 kilometre radius of National Heart Foundation centres	School students in eight states and territories	Householders in private dwellings in eight states and territories
Collection design	24-hour dietary recall interview	24-hour dietary record, administrator assisted	24-hour dietary recall interview
Collection methodology	Centralised collection, postal advice of selection	School-based collection	Household-based collection
Age group	25–64	10–15	2 and over
Season	May to November 1983	May to October 1985	February 1995 to March 1996
Interview days	Monday to Friday (dietary intake data for Sunday to Thursday)	Monday to Friday (dietary intake data for Monday to Friday)	Monday to Sunday (dietary intake data for Sunday to Saturday)
Weighting factors	Post-stratification ratio estimates by age group, sex, country of birth and geography (capital city)	Post-stratification ratio estimates by age, sex and geography (state)	Person-specific weights adjusted for regional probability of selection and non-response (based on a number of geo-demographic characteristics)
Coding procedures	Coded by interviewers using a hard copy coding manual	Coded by DCSH nutritionists using hard copy coding manual	Coded by specially trained staff using a computer-based coding system (ANSURS)
Food composition database	1983 survey nutrient composition database	1985 survey nutrient composition database	1995 NNS nutrients composition database

Source: Cook et al. 2001a.





Table 7.17: Estimated 24-hour intake of different foods, aged 25–64, Australian capital cities, 1983 and 1995

Food group	Mean intake (grams)		Proportion consuming (per cent)	
	1983	1995 ^(a)	1983	1995 ^(a)
Men				
Alcoholic beverages	456	*369	53	39
Cereals and cereal products	228	*271	97	92
Fish and seafood products and dishes	22	*30	19	19
Fruit products and dishes	173	*139	59	53
Meat, poultry and game products and dishes	210	205	91	84
Milk products and dishes	317	324	95	94
Non-alcoholic beverages (excluding plain drinking water)	1,108	*1,274	98	97
Sugar products and dishes	28	*22	81	73
Vegetable products and dishes	298	284	91	89
Legume and pulse products and dishes	6	*15	5	10
Women				
Alcoholic beverages	100	100	34	24
Cereals and cereal products	151	*192	97	95
Fish and seafood products and dishes	18	*26	20	20
Fruit products and dishes	181	*133	70	60
Meat, poultry and game products and dishes	128	*115	86	75
Milk products and dishes	260	245	95	94
Non-alcoholic beverages (excluding plain drinking water)	1,067	*1,159	99	98
Sugar products and dishes	18	*15	72	62
Vegetable products and dishes	239	229	92	89
Legume and pulse products and dishes	4	*10	5	8

(a) Results adjusted for sample design differences and for changes in the Australian population between 1983 and 1995.

* Statistically significant at the $p < 0.01$ level.

Source: Cook et al. 2001b.





Table 7.18: Estimated 24-hour intake of different foods, aged 10–15, 1985 and 1995

Food group	Mean intake (grams)		Proportion consuming (per cent)	
	1985	1995	1985	1995
Boys				
Cereals and cereal products	214	237	97	98
Fish and seafood products and dishes	9	*17	10	12
Fruit products and dishes	126	125	60	52
Meat, poultry and game products and dishes	138	139	85	79
Milk products and dishes	542	*484	95	92
Non-alcoholic beverages (excluding plain drinking water)	490	*724	83	87
Sugar products and dishes	17	*27	75	61
Vegetable products and dishes	194	203	82	79
Girls				
Cereals and cereal products	159	176	96	96
Fish and seafood products and dishes	8	*15	11	11
Fruit products and dishes	123	128	69	59
Meat, poultry and game products and dishes	106	107	83	78
Milk products and dishes	372	349	95	91
Non-alcoholic beverages (excluding plain drinking water)	459	*592	84	86
Sugar products and dishes	11	*26	68	55
Vegetable products and dishes	161	181	84	84

* Statistically significant at the $p<0.01$ level.

Source: Cook et al. 2001b.



Key points

- Chronic disease is the major contributor to the total burden of disease in Australia. Poor dietary intake increases the risk of developing many of these diseases.
- In 2007–08, people who live in more disadvantaged areas are more likely to smoke, be less active, be overweight or obese, and have fewer serves of fruit and vegetables.
- The mean height and weight of schoolchildren have increased in the past century.
- In 2007–08, 25% of children had unhealthy body weights and 61% of adults were either overweight or obese.
- Although the intake of most micronutrients is sufficient, intakes of vitamin D, iodine, folic acid and iron are insufficient in some subpopulations.

Nutritional status and health

8





8.1 Nutritional status

Nutrition is a key determinant of our health and wellbeing. A person's nutritional requirements are based on what is needed to ensure their body functions effectively and that they are able to stay healthy. Generally, age, sex, height and weight, physical activity level and disease status affect nutritional requirements. The assessment of nutritional status can be measured in a variety of ways, including anthropometric measurements (such as height and weight), biochemical tests, clinical indicators and dietary assessments. While the previous chapter focused mainly on assessment of dietary intakes, this chapter focuses on the other measures.

Anthropometric measurements

Birthweight

High and low birthweight babies are at a greater risk of poor health, disability and death than normal birthweight babies (Box 8.1). Factors that influence birthweight include maternal body size and age, nutrition during pregnancy, multiple fertility, smoking and alcohol consumption, and maternal and fetal infection. Birthweight, at term, is a good indicator of maternal health and nutritional status both before and during pregnancy. Where low birthweight babies are premature, this is generally not a nutritional issue.

Box 8.1: Birthweight definitions

Categories of weight at birth:

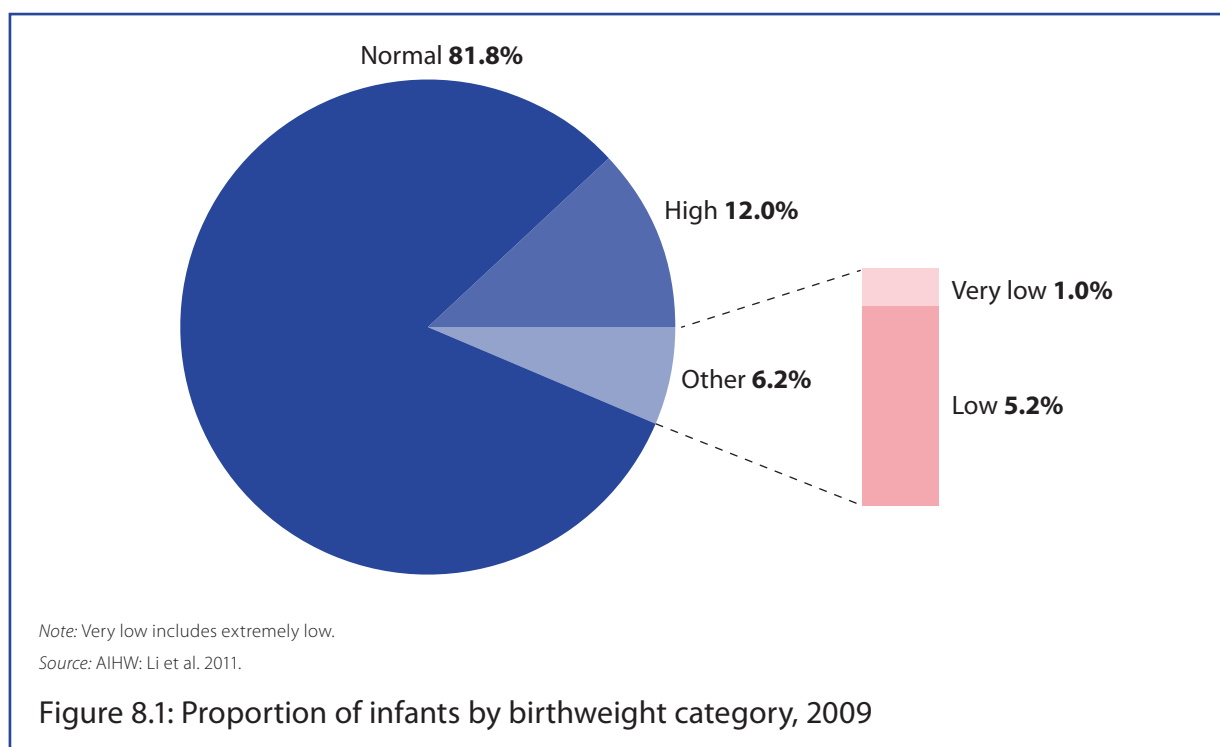
- extremely low: less than 1,000 grams
- very low: less than 1,500 grams
- low: less than 2,500 grams
- normal: 2,500–3,999 grams
- high: 4,000 grams or greater.

Source: WHO 1992.

In 2009, 6.2% (about 18,000) of live born babies had low birthweights, the lowest figure in a decade. Of these, 1.0% (about 3,000) had very low birthweights and half of these (0.5% or about 1,300) were considered extremely low birthweights. On the other end of the scale, there were 12.0% of live born babies with a high birthweight (AIHW: Li et al. 2011) (Figure 8.1).

Mothers aged 30–34 had the smallest proportion of live born babies with low birthweights (5.6%). Younger and older mothers had higher proportions of live born, low birthweight babies (8.6% for mothers aged under 20 and mothers aged 40–44, and 14.1% for mothers aged 45 and over). Although the proportion of live born, low birthweight babies born to Indigenous mothers has been declining over the past decades, it is still double the proportion (12.0%) of non-Indigenous mothers (5.9%). In addition, from 1988 to 2005, there was an 0.8% increase per year in the proportion of live born, high birthweight Indigenous babies (Lahmann et al. 2009).





Body weight of children and adults

The most common anthropometric measures used for national nutritional surveillance are height, weight and the various indices derived from them. These measures provide information on the number of people who are overweight and underweight in the community. Further details on classifying body weight are in Box 8.2.

Children

In the 2007 Australian National Children's Nutrition and Physical Activity Survey, the prevalence of underweight, normal weight, overweight and obesity in children aged 2–16 was assessed using the body mass index (BMI) classifications developed by Cole and colleagues (2007). As shown in Table 8.1, about 5% of children were classified as underweight, 72% as normal weight, 17% as overweight and 6% as obese. Of concern is more than a quarter of children (28%) had body weights considered to be unhealthy.

Table 8.1: Australian children aged 2–16 by BMI category, 2007 (per cent)^(a)

	Age group (years)	Underweight	Normal	Overweight	Obese
Boys	2–3	5	74	17	4
	4–8	4	78	13	5
	9–13	6	69	18	7
	14–16	5	71	19	6
Girls	2–3	4	78	14	4
	4–8	4	75	15	6
	9–13	5	65	23	7
	14–16	5	72	16	7
Children	2–16	5	72	17	6

(a) Population weights applied.

Source: 2007 Children's Survey (CSIRO & University of South Australia 2008).



Box 8.2: Classifying body weight

Body mass index (BMI) and waist circumference are the two main measures used for monitoring body weight. The most common measure is the BMI (particularly in self-report surveys), as people are more likely to know their height and weight than their waist circumference. The BMI is calculated by dividing weight in kilograms by the square of height in metres (kilograms/height in metres²).

The standard classification of BMI recommended by the WHO for adults is based on the association between BMI and illness and mortality (WHO 2000), and is:

- underweight: BMI < 18.5
- healthy weight: BMI ≥ 18.5 and BMI < 25
- overweight but not obese: BMI ≥ 25 and BMI < 30
- obese: BMI ≥ 30.

This classification may not be suitable for all ethnic groups. Compared with the rest of the population, some groups may have equivalent levels of risk at lower BMI (for example, Asians) or higher BMI (for example, Polynesians).

A waist circumference of 94 centimetres or more in men and 80 centimetres or more in women indicates increased risk (referred to here as abdominal overweight). A waist circumference of 102 centimetres or more in men and 88 centimetres or more in women indicates substantially increased risk. This classification is not applicable for people aged under 18 and the cut-off points may not be suitable for all ethnic groups.

Classifying body weight in children

Because the relationship between height and weight varies as children grow, the BMI classification for adults is not suitable for children. Different cut-offs are needed by age and sex. For children and adolescents aged 2–17, Cole and colleagues (Cole et al. 2000, 2007) have developed a separate classification of overweight, obesity and thinness, based on age and sex.

Differences in self-reported BMI compared with measured BMI

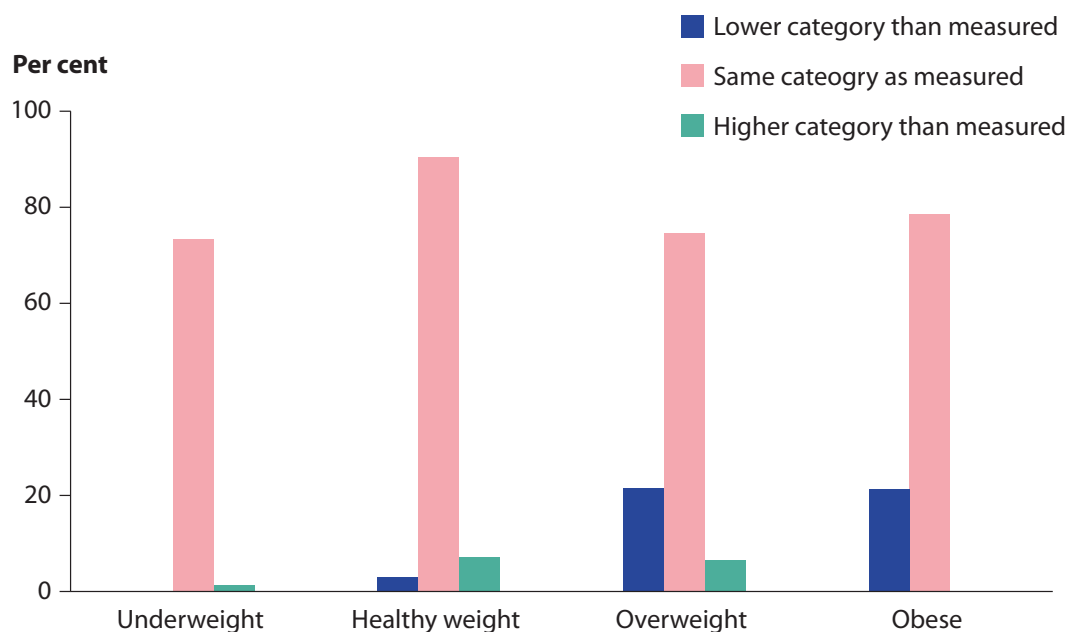
Obesity prevalence is not regularly measured in a systematic manner, making it difficult to accurately monitor changes over time (Australian Parliament 2009). Further, height and weight data may be collected in surveys as measured or self-reported data. People tend to overestimate their height and underestimate their weight, leading to an underestimation of BMI (Figure 8.2). Thus, rates of overweight and obesity based on self-reported data are likely to be underestimates of the true rates, and should not be directly compared with rates based on measured data.

Source: AIHW 2010b.

The majority of children outside the healthy weight range were either overweight or obese (23%). The proportion of children with excess weight was similar in boys and girls, both peaking in the 9–13 age group (Figure 8.3). Although all children gain weight as they grow and develop, excess body weight occurs when there is an imbalance between the amount of energy consumed and that expended.

Excess weight in children increases the risk of poor health during childhood and is a risk factor for poor health and mortality in adulthood. Compared with children of normal weight, overweight or obese children are at a greater risk of developing chronic conditions such as asthma and Type 2 diabetes. In addition, these children can experience victimisation and teasing that can affect their psychological wellbeing (Janssen et al. 2003).

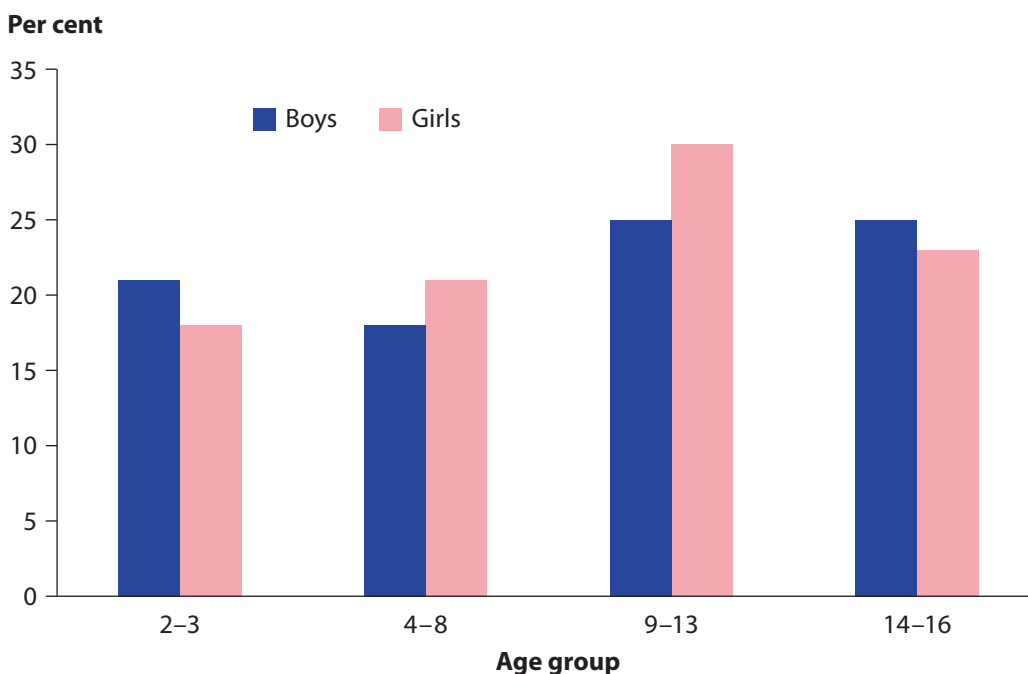




Note: BMI for people for whom self-reported height and weight, or measured height and weight were not known, are not included in this figure.

Source: AIHW analysis of the 2007-08 NHS.

Figure 8.2: BMI from self-reported height and weight compared to BMI from measured height and weight, persons aged 18 and over, 2007-08



Source: 2007 Children's Survey (CSIRO & University of South Australia 2008).

Figure 8.3: Children aged 2 to 16 who are overweight or obese, by age group, 2007



Between 1985 and 1995, levels of excess body weight in children almost doubled for both boys and girls (Margery et al. 2001). Since 1995, the levels have continued to increase, but not as dramatically (Table 8.2). It is uncertain if childhood overweight and obesity rates have stabilised or are continuing to rise (Gill et al. 2009; Olds et al. 2010). Further monitoring is required to answer this question.

Table 8.2: Excess body weight in children aged 5–17, by year of survey (per cent)

Sex and excess weight	1995 National Nutrition Survey	2007–08 National Health Survey
Boys		
Overweight only	16.0	16.2
Obese only	4.5	9.3
Overweight or obese	20.5	25.5
Girls		
Overweight only	15.3	18.2
Obese only	5.8	5.6
Overweight or obese	21.1	23.8

Source: ABS 2009f.

Adults

An OECD report (Franco 2010) showed that in 19 OECD countries, more than half of the adult population were classified as being overweight or obese. Australia ranks fifth out of the OECD countries for the proportion of the population who are obese (25%), behind the United States (34%), Mexico (30%), New Zealand (27%) and Chile (25%). According to an earlier report (OECD 2007), the rate of obesity has almost tripled in Australia during the last 20 years (using consistent measures over time).

The increasing prevalence of obesity has an economic impact that costs individuals and society. Access Economics (2008) estimated that in 2008 the economic cost of obesity was \$8.3 billion. This includes \$3.6 billion for lost productivity (44%), \$2.0 billion for the health system (24%) and \$1.9 billion for carers (23%). With the addition of the net cost of lost wellbeing of \$49.9 billion, the total cost was estimated at \$58.2 billion.

In the 2007–08 National Health Survey, almost two-thirds (61%) of all adults had a BMI (based on measured data) that indicated they were either overweight or obese. Compared with women (55%), a larger proportion of men were overweight or obese (68%) (Table 8.3). Prevalence tended to increase with age, but then decreased after the age of 75.



Table 8.3: Population distribution by BMI classification, based on measured data, people aged 18 and over, 2007–08 (per cent)

Sex and BMI	18–24	25–34	35–44	45–54	55–64	65–74	75+	Total 18+
Men								
Underweight	3.6	2.2	n.p.	n.p.	n.p.	n.p.	n.p.	1.2
Normal	56.6	35.9	28.5	22.8	n.p.	n.p.	24.7	31.1
Overweight	28.0	42.5	44.2	47.0	40.0	44.9	52.8	42.2
Obese	11.9	19.5	26.6	29.7	34.9	34.0	21.5	25.5
<i>Total men</i>	<i>100.0</i>	<i>100.0</i>	<i>100.0</i>	<i>100.0</i>	<i>100.0</i>	<i>100.0</i>	<i>100.0</i>	<i>100.0</i>
Women								
Underweight	7.2	3.4	1.9	1.7	n.p.	n.p.	2.5	2.7
Normal	58.0	52.2	43.0	39.6	n.p.	n.p.	40.6	42.6
Overweight	20.7	26.4	32.4	32.5	34.7	42.0	32.6	31.0
Obese	14.2	18.0	22.7	26.3	33.2	29.4	24.3	23.6
<i>Total women</i>	<i>100.0</i>	<i>100.0</i>	<i>100.0</i>	<i>100.0</i>	<i>100.0</i>	<i>100.0</i>	<i>100.0</i>	<i>100.0</i>

n.p. not published (data cannot be released due to quality issues, confidentiality, or permission not granted).

Source: AIHW analysis of the 2007–08 NHS.

Waist circumference

A person's waist circumference is a measure of abdominal fatness and is an independent risk factor for many chronic diseases—risk increases with increasing waist circumference (Klein et al. 2007; Malik et al. 2004; Sung & Ryu 2004) (Box 8.2).

In the 2007–08 National Health Survey, almost 60% of adults had waist circumferences that increased their risk of poor health, with 35% at a substantially increased risk (Table 8.4). Waist circumference increased with age for both men and women.

Table 8.4: Waist circumference risk for chronic disease by age group and sex, 2007–08 (per cent)

Sex and risk level	18–24	25–34	35–44	45–54	55–64	65–74	75+	Total 18+
Men								
Not at risk	79.6	59.7	42.8	37.1	28.4	22.1	25.1	46.4
At increased risk	11.1	19.4	27.5	28.4	28.7	31.9	29.9	24.0
At substantially increased risk	9.2	20.9	29.7	34.6	42.9	46.1	45.1	29.6
Women								
Not at risk	66.7	45.7	37.7	33.2	22.0	16.6	20.6	29.0
At increased risk	14.6	22.2	23.8	24.2	22.0	28.3	22.3	31.0
At substantially increased risk	18.7	32.1	38.5	42.6	55.9	55.1	57.2	40.0
Persons								
Not at risk	72.3	53.1	40.2	35.2	25.3	19.4	22.6	42.2
At increased risk	12.9	20.7	25.7	26.3	25.5	30.1	25.7	23.1
At substantially increased risk	13.9	26.2	34.1	38.5	49.2	50.6	51.6	34.8

Source: AIHW analysis of the 2007–08 NHS.



Growth rates of children

Appropriate nutrition in the early years forms the basis for a healthy adult life. Growth is an important indicator of nutritional status in children, and the most common measures are height for age, weight for age and weight for height.

There have been no regular, national, representative surveys of children's weights and heights, so it is difficult to describe trends over time. The only source of data showing changes in mean height and weight from the same population over the past 100 years comes from the New South Wales Department of Health (Jones et al. 1973). The height and weight of New South Wales school students aged 5–19 were studied in four surveys (1915, 1937, 1954 and 1970) (Jones et al. 1973).

As shown in Table 8.5, the mean height and weight of schoolchildren across three age groups has increased steadily during the past century. This is most likely the result of environmental factors such as improvements in infection control, better living conditions and increased access to food.

Table 8.5: Secular trends in Australian schoolchildren's height and weight, 1915 to 2008

		Mean height (centimetres)			Mean weight (kilograms)		
		Age group (years)					
		5	10	15	5	10	15
Boys	Year						
	1913–15 ^(a)	108	133	159	18.6	28.4	47.0
	1937 ^(a)	111	137	166	19.3	30.6	53.8
	1954 ^(a)	112	139	169	20.6	33.6	58.4
	1970 ^(a)	112	139	169	20.3	33.9	58.1
	1985 ^(b)	–	141	170	–	34.3	59.7
	1995 ^(c)	114	141	174	20.7	35.3	64.1
	2007–08 ^(d)	114	146	172	21.1	40.9	66.1
Girls	1913–15 ^(a)	107	132	157	18.1	28.2	47.4
	1937 ^(a)	109	136	160	18.9	30.6	51.9
	1954 ^(a)	111	139	162	20.1	34.0	55.9
	1970 ^(a)	111	139	160	20.0	33.8	53.4
	1985 ^(b)	–	141	162	–	34.8	55.1
	1995 ^(c)	113	143	163	20.9	38.7	56.5
		2007–08 ^(d)	112	144	164	20.1	37.1

(a) NSW Department of Health school children's survey.

(b) 1985 Australian Schools Health and Fitness Survey.

(c) AIHW analysis of 1995 National Nutrition Survey.

(d) 2007–08 NHS data.

Sources: Jones et al. 1973, Pyke 1987, ABS analysis of 2007–08 NHS data.

Nutrient intakes

Measuring nutrient intakes provides an indication of whether nutrient requirements are being met. Insufficient intake may mean an individual is deficient in particular nutrients. However, deficiencies can only be confirmed through biochemical assessments, such as of blood and urine, and clinical observations. To date, national surveys have included limited nutrition-related biological measures.

Most groups in the population have adequate intakes of protein and most micronutrients when compared with recommended nutrient reference values. Nutrients of potential concern for specific subpopulations are listed opposite.





Vitamin D

Vitamin D is needed for the development and maintenance of bone. It helps the body absorb calcium in the small intestine and ensures the proper renewal and mineralisation of bone tissue (NHMRC & NZMoH 2006). Poor vitamin D status has been linked to an increased risk of malignancies, chronic inflammatory diseases and autoimmune diseases (Holick 2004).

This vitamin is not a nutrient in the usual sense, as it is produced by the action of sunlight on skin. Dietary supplies of vitamin D are required only by those without sufficient exposure to sunlight; the amount needed depending on the shortfall from exposure to solar ultraviolet radiation. Therefore, information on dietary vitamin D intake alone is not enough to determine an individual's vitamin D status.

Previously, it was thought vitamin D insufficiency in Australia was confined to certain high-risk groups, such as the institutionalised elderly, veiled women and their breastfed babies. In recent years, there has been debate about what level of vitamin D is appropriate for health and this affects the interpretation of prevalence data. There is also a further problem of non-standardisation of methods across laboratories.

It has been suggested that significant numbers of Australians have low levels of circulating vitamin D (Working Group of the Australian and New Zealand Bone and Mineral Society Endocrine Society of Australia and Osteoporosis Australia 2005). This may be due to people spending more time indoors and having less exposure to sunlight, as well as adhering to the 'slip slop slap' message (Nowson 2006).

Until recently, there has been limited published information on the prevalence of vitamin D deficiency in Australia, except for small subpopulations (Nowson & Margeterison 2002). The National Health Measures Survey, as part of the Australian Health Survey, will measure vitamin D status in the population aged 12 and over, and be part of an international study on laboratory methods (DoHA 2011).

In developing public health messages for vitamin D, it is important to balance the need to maintain adequate sun exposure for vitamin D synthesis while minimising the risk of skin cancer (Cancer Council Australia 2008).

Iodine

Iodine is required for normal thyroid function, growth and development and is especially important for the brain during fetal and postnatal life (Delange 2000). It is recommended all women who are pregnant, breastfeeding, or considering pregnancy take an iodine supplement of 150 micrograms a day (NHMRC 2010b).

Common iodine sources include seafood, dairy, foods grown in iodine-replete soils, and iodised table salt. Iodine deficiency is associated with a range of adverse health effects depending on the degree of deficiency. In children deficiency can impair the development of the brain and nervous system and in adults can increase the risk of thyroid dysfunction (ICCIDD et al. 2007). Excess iodine can also have adverse health effects and although the Australian population is considered to be deficient, some population groups may be prone to excessive intakes.

Historically, parts of Australia have experienced iodine deficiency due to the naturally low iodine content of soils in many areas. In the 1960s to 1980s, additional dietary iodine sources were available and, as a result, most Australians were thought to be iodine replete. However, from the 1990s, studies emerged suggesting mild iodine deficiency in some parts of Victoria, New South Wales and Tasmania (APHDPC 2007).

The most widely used biochemical method to assess population iodine status is to measure urinary iodine concentration, which closely reflects recent dietary intakes. The median urinary iodine concentration (MUIC) of schoolchildren aged about 10 is frequently used as an indicator of population iodine status, with a MUIC between 100 and 199 micrograms per litre considered optimal (ICCIDD et al. 2007).





In 2004, the National Iodine Nutrition Survey (NINS) of 1,709 school-aged children in the five mainland states of Australia confirmed mild iodine deficiency in the population (Li et al. 2006; Li et al. 2008) (Table 8.6).

Mandatory iodine fortification of bread was introduced in October 2009 to help address the re-emergence of iodine deficiency in the population. This strategy is being monitored to ensure its ongoing effectiveness and safety in reducing iodine deficiency (AIHW 2011g). The National Health Measures Survey will assess the iodine status of the population aged 5 and over by measuring MUIC (DoHA 2011).

Table 8.6: Australian NINS Median Urinary Iodine Concentration Data

State	Median urinary iodine concentration (µg/L) ^(a)	Interquartile ranges (µg/L)	Iodine status
New South Wales	89.0	65.0–123.5	Mild deficiency
Victoria	73.5	53.0–104.3	Mild deficiency
South Australia	101.0	74.0–130.0	Borderline deficiency
Western Australia	142.5	103.5–214.0	Adequate
Queensland	136.5	104.0–183.8	Adequate
Weighted total	96.0		Mild Deficiency

(a) According to the WHO and ICCIDD, an MUIC of 50–99 µg/L indicates mild iodine deficiency in a population.

Sources: Li et al. 2006; Li et al. 2008.

Folic acid

Folic acid is the synthetic form of the B group vitamin folate, used in supplements or added to food (fortified). It is recommended that in addition to folate from their normal diet, women who can become pregnant should consume an additional 400 micrograms of folic acid per day, as a supplement or from fortified food, to help prevent neural tube defects (NTDs) in their babies (NHMRC & NZMoH 2006). Before mandatory fortification in 2009, it was estimated that the intake of folic acid by women of child-bearing age (16–44) in Australia was 108 micrograms per day (FSANZ 2007b), well below the recommended 400 micrograms.

Measures of folate status include the assessment of folate in red blood cells (RBC) and serum. Serum folate concentrations are a sensitive index (Metz et al. 2002) and reflect recent changes in dietary intake or temporary changes in folate metabolism (Gibson 2005). RBC folate concentrations are less sensitive than serum folate concentrations to short-term fluctuations and reflect folate stores (Gibson 2005).

While there is no accepted value for folate deficiency or inadequacy based on RBC or serum folate concentrations to reduce NTDs (Choumenkovitch et al. 2001), various cut-off points have been used. Daly and colleagues (1995) found that NTD risk is associated with RBC folate and serum folate levels, both in a continuous dose-response relationship (Figure 8.4). There was a more than eightfold difference in the risk between those with RBC folate levels less than 340 nanomoles/L and those with levels of 906 nanomoles/L or higher. Although they were unable to determine an optimum level of RBC folate for NTD prevention, they assumed no additional protective effect beyond 1,292 nanomoles/L.



Risk of NTD	RBC folate	Serum folate
Higher	≤ 339 nmol/L	≤ 4.4 nmol/L
	340–452 nmol/L	4.5–6.7 nmol/L
	453–679 nmol/L	6.8–11.2 nmol/L
	680–905 nmol/L	11.3–15.8 nmol/L
Lower	≥ 906 nmol/L	≥ 15.9 nmol/L

Source: Daly et al. 1995.

Figure 8.4: Risk of neural tube defects by red blood cell or serum folate concentration

There are no nationally representative data on RBC folate status for Australian women of child-bearing age. The Child Determinants of Adult Health (CDAH) study does, however, have national data on the serum folate status of women aged 26–36.

From 2004 to 2006, serum samples were collected from 991 non-pregnant women. Median serum folate for this group was 27.1 nanomoles/L. Some women (7%) had serum folate levels classified as low (< 11.0 nanomoles/L) and were at higher risk of having an NTD-affected pregnancy. Serum folate levels were positively associated with folic acid supplement use, higher education and occupation levels, urban living, not smoking and healthy weight. No association was evident between serum folate and age, marital status or birth order (Seal et al. 2010).

To help reduce the incidence of NTDs, it has been mandatory since September 2009 that most bread in Australia contain added folic acid. Like the mandatory iodine fortification, this initiative will be monitored to ensure its ongoing effectiveness and safety (AIHW 2011g). The National Health Measures Survey will measure both serum and RBC folate status in the population aged 12 and over (DoHA 2011). This information will help determine the effectiveness and safety of mandatory fortification.

Iron

Although iron deficiency is the most common micronutrient deficiency in the world (Gibson 2005), the prevalence in Australian is largely unknown. Depletion of iron stores and iron deficiency can occur in all age groups, but those at increased risk include infants, young children, women of child-bearing age and disadvantaged populations such as Indigenous Australians, refugees and recent migrants.

Dietary inadequacy occurs when iron requirements are not met by iron absorption from the diet and stores are low or exhausted. The three common causes are excess iron loss (bleeding), inadequate dietary intake and/or malabsorption. The consequences of deficiency include:

- decreased work capacity and aerobic performance
- cognitive impairment and intellectual impairment
- adverse pregnancy outcomes
- impaired immune function (WHO 2001).

Iron deficiency is determined using combinations of measures, so various studies find different results depending on which measures and cut-off points are used. The following studies suggest that, over the past three decades, iron deficiency continues to be of concern for some population groups.



- The 1989 Risk Factor Prevalence Study investigated plasma iron, transferrin and ferritin levels in 1,704 men and 4,267 women aged 20–69. Iron deficiency was identified in 0.4% of men and 7.5% of women. In women, deficiency was greatest during reproductive years (20–49) and markedly less after menopause (50–69) (NHF 1991).
- In 1990, Leggett and colleagues investigated serum ferritin concentrations from 1,968 employees (age range 17–65) from two large Australian corporations. They found the prevalence of iron deficiency (serum ferritin < 10 micrograms/L) was 2.6% for men and 8.9% for women (Leggett et al. 1990).
- In 1996, baseline data from the Australian Longitudinal Study on Women's Health suggested that 1 in 3 women had been diagnosed with iron deficiency by the age of 45–50 (Patterson et al. 2000).
- In 2008, Ahmed and colleagues investigated serum ferritin concentrations from 1,634 Queensland adults (688 men and 946 women), aged 25 and over, as part of the Australian Diabetes, Obesity and Lifestyle Study. The prevalence of iron deficiency (serum ferritin < 12 micrograms/L) was 10.6% for women under 50 and 2.8% for women aged 50 and over, and 0.3% for men (Ahmed et al. 2008).

Iron deficiency anaemia occurs when iron deficiency results in decreased red blood cell production, leading to anaemia. The National Health Measures Survey will measure the serum ferritin and haemoglobin levels in the population aged 12 and over to assess the prevalence of iron deficiency and iron deficiency anaemia in these groups (DoHA 2011).

8.2 Risk factors

A person's health and wellbeing is influenced by a complex interplay of societal, environmental, socioeconomic, biological and lifestyle factors. A risk factor is anything that increases the possibility of someone getting a disease or health condition. Many chronic diseases share common risk factors and while some of these are modifiable, others are not (Table 8.7). Food and nutrition feature in a number of modifiable risk factors, including poor diet in general, excess weight (overweight and obesity), high blood pressure and high blood cholesterol.

Each risk factor is frequently associated with many chronic diseases and their relationship is often interrelated and continuous. Many risk factors also have an additive or multiplicative interaction. For these reasons, it is important that risk factors are not considered in isolation. For example, poor diet can increase the risk of developing biomedical risk factors such as excess weight, high blood pressure and high blood cholesterol. Table 8.8 highlights the relationships between selected chronic diseases and modifiable risk factors.

Table 8.7: Risk factors for chronic diseases

Modifiable risk factors			
Behavioural	Biomedical	Broad influences	Non-modifiable risk factors
Tobacco smoking	Excess weight	Socio-environmental factors	Age
Risky alcohol consumption	High blood pressure	Psychosocial factors	Gender
Physical inactivity	High blood cholesterol	Early life factors	Indigenous status
Poor diet	Other	Political factors	Ethnic background
Other			Family history
			Genetic make-up

Source: AIHW 2006.



Table 8.8: Relationship between selected chronic diseases and modifiable risk factors

Conditions	Behavioural				Biomedical		
	Tobacco smoking	Physical inactivity	Risky alcohol consumption	Poor diet	Obesity	Hypertension ^(a)	High blood fats
Ischaemic heart disease	✓	✓		✓	✓	✓	✓
Stroke	✓	✓	✓	✓	✓	✓	✓
Type 2 diabetes	✓	✓		✓	✓		
Kidney disease	✓	✓		✓	✓	✓	
Arthritis	✓ ^(b)	✓ ^(c)			✓ ^(c)		
Osteoporosis	✓	✓	✓	✓			
Lung cancer	✓						
Colorectal cancer		✓	✓	✓	✓		
Chronic obstructive pulmonary disease	✓						
Asthma	✓						
Depression		✓	✓		✓		
Oral health	✓		✓	✓			

(a) High blood pressure.

(b) Relates to rheumatoid arthritis.

(c) Relates to osteoarthritis.

Note: The relationships shown highlight the causation of a chronic disease with a particular risk factor. They do not reflect a risk factor's influence on chronic disease management. For example, risky alcohol consumption may be a risk to the management of Type 2 diabetes.

Source: AIHW 2012b.

There is increasing evidence that some disease risks, such as coronary heart disease, begin in fetal life and continue into old age, so a chronic disease diagnosed in later life can reflect a lifelong exposure to damaging physical and social factors (Darnton-Hill et al. 2004). As most chronic diseases have a complex causality, with multiple factors leading to their onset, estimating the joint effects of multiple risks is complex. Attempts to quantify the effect of diet-related risk factors on the burden of disease are described in Section 8.4.

8.3 Diet-related diseases

As noted in Section 8.2, poor dietary choices increase the risk of developing many chronic diseases. These include coronary heart disease, stroke, hypertension, atherosclerosis, obesity, some forms of cancer, Type 2 diabetes, osteoporosis, dental caries, gall bladder disease, dementia and nutritional anaemias (NHMRC 2010c). Fruit and vegetable consumption is strongly linked to the prevention of chronic disease (NHMRC 2003a).

AIHW estimated that poor diet costs the nation \$5 billion each year, which includes direct health-care costs of \$3 billion (AIHW: Begg et al. 2007). This figure grows when overweight and obesity, of which poor diet and physical inactivity are causal factors, are considered; costing the nation an additional \$11.6 billion per year (Queensland Public Health Forum 2009).



Access Economics (2008) estimated the health effects of obesity, reporting that a large percentage of Type 2 diabetes (24%), cardiovascular disease (21%), osteoarthritis (25%) and colorectal, breast, uterine and kidney cancer (21%) were attributable to obesity.

The National Health Measures Survey will measure a range of markers for diet-related diseases in the population aged 12 and over (for those aged 5–11, urine tests only will be performed). These include markers for cardiovascular disease (total cholesterol, high density lipoprotein, low density lipoprotein, triglycerides and blood pressure), Type 2 diabetes (fasting plasma glucose, HbA1c), and other markers for chronic kidney disease and liver damage (DoHA 2011).

8.4 Burden of diet-related disease

Chronic diseases are the major contributors to the total burden of disease in Australia. In 2003, the leading contributors were cancers, cardiovascular diseases and mental disorders (AIHW: Begg et al. 2007). Burden of disease studies attempt to quantify the effect of selected risk factors (separately or in combination) on individual or population health. Techniques for attributing health outcomes to specific health risks have been developed and used as a basis for estimating the burden of diet-related disease (WHO 2002; Ezzati et al. 2004; AIHW: Begg et al. 2007).

AIHW estimated that inadequate fruit and vegetable consumption was responsible for 2.1% of the total burden of disease in Australia in 2003 (AIHW: Begg et al. 2007). Despite this estimate, there is a general lack of up-to-date data on the overall contribution of total diet to the burden of disease in Australia.

The Global Burden of Disease 2000 study reported that about 15% of global disease was attributable to the effects of under-nutrition and micronutrient deficiencies. However, these conditions are generally less common in Australia and other developed countries. A similar amount of disease was also due to risk factors with significant dietary components, namely being overweight, high blood cholesterol, hypertension and low intakes of fruit and vegetables (Ezzati et al. 2002). Of the total global burden of disease, 1.8% was estimated to be due to inadequate intakes of fruit and vegetables, 2.3% from being overweight or obese, 2.8% from high cholesterol and 4.1% from tobacco smoking (Lock et al. 2005).

Poor diets contribute to the overall burden of disease; improving the nutritional status of Australians can play an important role in addressing the increase in many chronic diseases.

8.5 Equity and health issues

Health inequities are differences in health that are 'unnecessary, avoidable, unfair and unjust' (Whitehead 1992). This concept describes differences in health status between population groups. Health and wellness follows a social gradient—the lower the socioeconomic position, the worse the health. The social gradient of health within countries is caused by the unequal distribution of income, goods and services, education, capabilities and opportunities (Marmot et al. 2008).

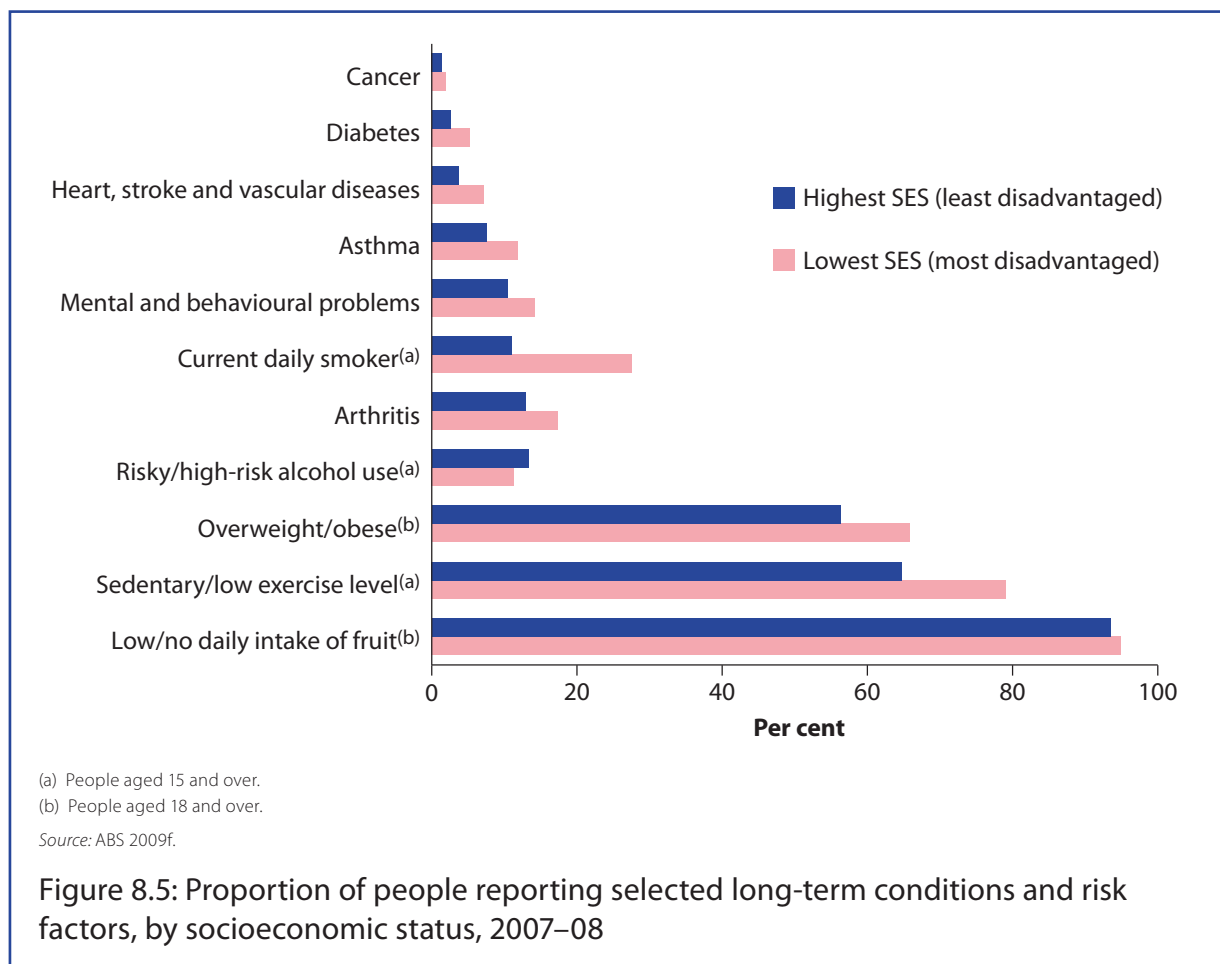
In Australia, Aboriginal and Torres Strait Islander people, people in regional and remote areas, socioeconomically disadvantaged people and people with disabilities display different levels of health disadvantage.

The extent to which equity influences food choices and food behaviours and how this affects health status is largely unknown and difficult to untangle. However, health inequalities do exist between people living in the least and most socioeconomically disadvantaged areas.





Results from the 2007–08 National Health Survey indicate that people living in the lowest socioeconomic status areas are more likely to smoke, be less active, be overweight or obese, and have fewer serves of fruit and vegetables. They are also more likely to suffer from chronic diseases such as diabetes, heart disease and cancer, and die at younger age than the rest of the population (AIHW 2012a). In contrast, risky alcohol use is greater for people living in areas of higher socioeconomic status (Figure 8.5).



Indigenous Australians generally have more ill health, disability and a lower quality of life than other Australians, and also die at much younger ages. They suffer an overall burden of disease 2.5 times that of the total Australian population (Vos & University of Queensland Centre for Burden of Disease and Cost-Effectiveness 2007). Two-thirds of this health gap is due to mortality and one-third to disability. During 2005–2007, the life expectancy at birth for Indigenous Australians was estimated to be 67 years for males and 73 years for females. In contrast, life expectancy at birth for non-Indigenous Australians for the same period is 79 years for males and 83 years for females (ABS 2011h).

People in regional and remote areas tend to have higher levels of risk factors and more illness than people living in *Major cities*, and people with disabilities have poorer physical and mental health, and higher rates of risk factors such as smoking and being overweight (AIHW 2012a).

Key points

- Timely, reliable, consistent and accessible data on food and nutrition are needed to inform policy development and resource investment, and to evaluate outcomes and monitor trends.
- The four main components of a national food and nutrition monitoring and surveillance system are food supply, food purchasing and acquisition, food and physical activity behaviours, and nutritional status.
- The mandatory folic acid and iodine fortification monitoring framework agreed to by the Australian Population Health Development Principal Committee in August 2007 and the Australian Health Ministers' Advisory Council in October 2007 highlights the different data sources needed to monitor and assess the effectiveness of public health nutrition interventions.

Monitoring and surveillance





‘Monitoring’ typically focuses on detecting change in relation to defined goals, for example, comparing the nutritional or health status of the population to health standards such as recommended nutrient intakes. ‘Surveillance’ generally refers to the systematic collection and analysis of data to describe a particular system. However, these terms are frequently used interchangeably and the distinction between them is sometimes blurred.

For the purpose of this book, ‘food and nutrition monitoring and surveillance’ refers to the routine collection of food and nutrition data and its subsequent analysis for interpretation and reporting. Monitoring is essential to keep track of key aspects of the food and nutrition system both nationally, and for specific subpopulations (Rutishauser et al. 2007).

The ultimate goal of food and nutrition monitoring and surveillance is to promote the wellbeing of the population and maximise nutrition-related health. Information on all stages of the food system (discussed in previous chapters) is integral to the work of policy-makers, food regulators, health professionals, educators and health planners.

Key stakeholders of an Australian food and nutrition monitoring and surveillance system include Australian, state and local governments, the food industry, non-government organisations, planners and others who inform resource investment and research institutions (Table 9.1).

Rutishauser and colleagues (2007) outline the important questions that food and nutrition monitoring and surveillance data are able to answer, including:

- Is nutritionally adequate food available and accessible to all segments of the population?
- Is the composition of the food supply changing?
- Is the composition of people’s diets changing and are these changes in line with dietary targets and guidelines?
- What are the trends in eating patterns that may affect food industry growth and innovation?
- Is the nutritional status of the population changing? If so, is the change positive or negative?



Table 9.1: Users and uses of food and nutrition monitoring and surveillance data

Stakeholder	Uses
Australian Government	<i>Food:</i> Developing, monitoring and enforcing regulations and standards, developing food regulation policy, contributing to international standards, monitoring trends in self-sufficiency and adequacy of the food supply to meet population needs. <i>Nutrition:</i> Developing national food and nutrition guidelines, nutrient reference values, goals and targets, policies, strategies and programs, and providing nutrition services. <i>Nutrition-related health strategies:</i> Developing health strategies, for example, for chronic disease prevention and addressing inequalities between population sub-groups, and meeting international reporting obligations.
State and local government, public health agencies and primary care providers	Developing nutrition education and health promotion programs. Enforcing food standards. Developing regional and specific settings food and nutrition health policies and strategies. Guidance for service planning, resource allocation and a basis for client advice.
Food industry	Guiding primary produce research and development and marketing and distribution strategies. Food product development, labelling and marketing.
Non-government and consumer organisations	Nutrition and health-promotion policies, and programs and provision of advice to the public.
Research and academic institutions and health planners	Identifying relevant directions for applied research, including methods research for health and nutrition monitoring for health professional training.

Source: Rutishauser et al. 2007.





9.1 Monitoring and surveillance systems in other countries

Australia does not have a system for the collation of ongoing dietary data. The United States, United Kingdom and many European nations have regular programs for food and nutrition monitoring and surveillance.

In the United States, the National Health and Nutrition Examination Survey is a program of studies designed to assess the health and nutritional status of adults and children. The survey, which began in the 1960s, examines different population groups or health topics. In 1999, it became a continuous program focusing on a variety of health and nutrition measurements to meet emerging needs, such as potential vitamin D deficiency. The survey examines a nationally representative sample of about 5,000 people each year and includes demographic, socioeconomic, dietary, and health-related questions (National Center for Health Statistics 2012).

In the United Kingdom, the National Diet and Nutrition Survey is a continuous program of cross-sectional studies which assesses food consumption, nutrient intakes and nutritional status of people aged 18 months and older living in private households. It covers all four countries of the United Kingdom and is designed to be representative of the population (Department of Health 2011).

From 2011, the New Zealand Health Survey and the various components of the program will be integrated into a single survey of continuous operation. The rationale is to use the available resources effectively and improve the monitoring of the health of the New Zealand population and associated health inequalities (Ministry of Health 2010).

In 2011, the Dutch National Food Consumption Surveys were revised to enable continuous collection of basic data on the general Dutch population. From 2012, food consumption data on the total population aged 1–79 will be collected, which is expected to take several years (National Institute for Public Health and the Environment 2012). Additional and follow-up targeted surveys may be undertaken in specific population sub-groups when the food consumption survey indicates an inadequate or excessive intake of certain vitamins or minerals or as required. This may include nutritional status surveys.

9.2 Establishing a national monitoring and surveillance system in Australia

While the need for a national food and nutrition monitoring and surveillance system has been recognised and some initial work has commenced, further work is needed to establish a nationally coordinated system. The Australian Health Survey (discussed later) will make an important contribution to some of the elements required in such a system.

A summary of key activities which could inform the establishment of a national monitoring and surveillance system are presented in Table 9.2.



Table 9.2: Key dates and activities in establishing a monitoring and surveillance system

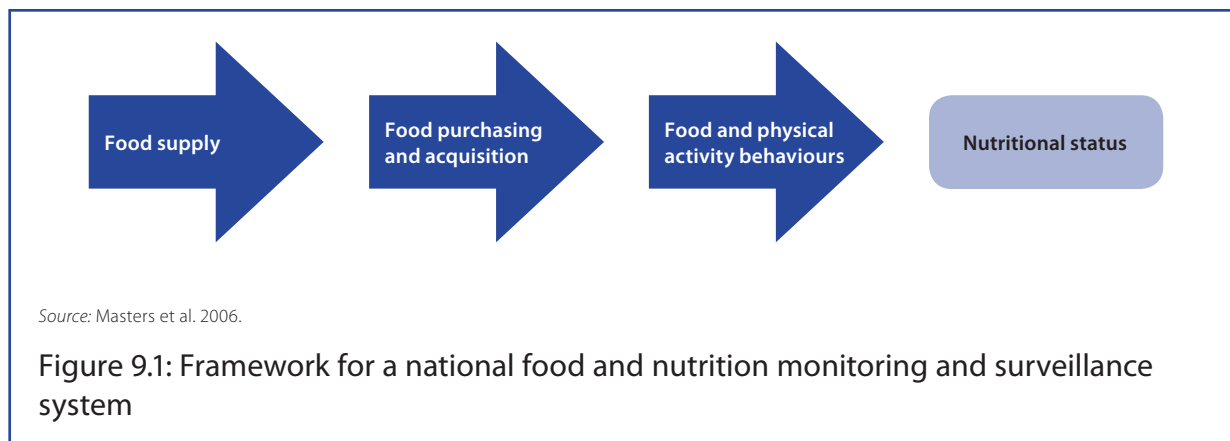
Date	Activity
1992	The National Food and Nutrition Policy is adopted, noting the need for a national food and nutrition monitoring and surveillance system (Commonwealth Department of Health & Housing and Community Services 1992).
1994	The AIHW releases the first edition of <i>Australia's food & nutrition</i> (AIHW: Lester 1994).
1995	<i>Plan for a national food and nutrition monitoring program</i> working paper is released (AIHW: Coles-Rutishauser & Lester 1995).
1995	<i>National nutrition survey Australia 1995</i> is undertaken (ABS 1998, 1999).
1997–2002	Australian Food and Nutrition Monitoring Unit prepares reports on the current food and nutrition situation in Australia (website: <www.health.gov.au>).
July 2005	Australian health ministers agree to support the establishment and implementation of an ongoing national food, nutrition and physical activity monitoring and surveillance system.
2006	A framework and business case is prepared for such a system (Masters et al. 2006). Australian health ministers request that a National Food Nutrition and Physical Activity Monitoring and Surveillance System working group convene to discuss governance, scope and costs of an ongoing national food and nutrition monitoring and surveillance system.
2007	National Children's Nutrition and Physical Activity Survey is conducted on 4,000 children aged 2–16 across all states and territories.
2007	The Australian Government agrees to fund a National Nutrition and Physical Activity Survey Program to collect comprehensive population data on food intake, physical activity, and physical measurements (weight, height, waist circumference and blood pressure), with an initial focus on adults.
2008	Additional funding is allocated to broaden the survey program to collect data on key chronic disease risk factors. Biomedical and self-reported measurements will be collected in a representative sample of children and adults across Australia.
2009–2010	The Australian National Preventative Health Strategy Taskforce Report recommends the development and implementation of a comprehensive National Food and Nutrition Framework to help combat growing rates of obesity in the population (National Preventative Health Taskforce 2009a). In response, the Australian Government agrees to consider this recommendation and consult industry, and states and territories (Australian Government 2010).
2010–2013	The Australian Health Survey, coordinated by the ABS, is conducted to collect dietary intake and physical activity data along with biomedical collection on a range of risk factors.
2011	The final report of the Independent Panel for the Review of Food Labelling, Law and Policy supports establishing a monitoring and surveillance system for dietary and nutrition practices that includes how food labels are used and understood—as part of a nutrition framework in a national nutrition policy. The Legislative and Governance Forum on Food Regulation and the Standing Council on Health supports the development of a national nutrition policy for Australia and refers the policy development to the AHMAC, to be commenced within 2 years.





9.3 Components of a monitoring and surveillance system

The components of a monitoring and surveillance framework have previously been identified and are currently being used to inform a future system. A report prepared by Masters and colleagues (2006) included a framework that built on the conceptual model of the relationship between food and health developed in the 1995 plan for a national food and nutrition monitoring program (Figure 9.1) (AIHW: Coles-Rutishauser & Lester 1995).



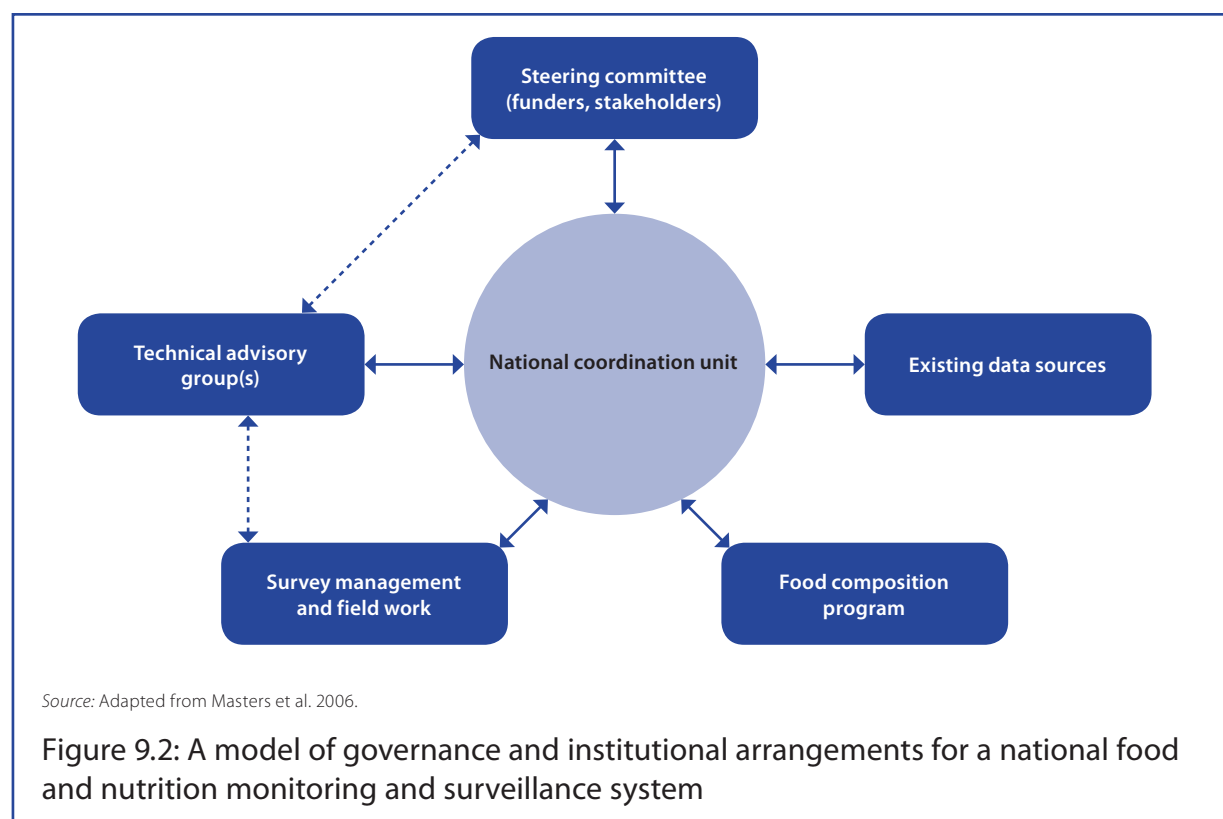
Framework infrastructure

The food supply element consists of the availability of foodstuffs and composition of Australian foods. Food purchasing and acquisition looks at expenditure on food, types of food purchased, price and quantities bought and food security. Food and physical activity behaviours include monitoring food and nutrient intakes and physical activity, while nutritional status is assessed through biological measures.



Governance and coordination

In their report, Masters and colleagues (2006) outlined the core infrastructure components and operational aspects of a food and nutrition monitoring and surveillance system (Figure 9.2).



The recommended components comprise:

- a national coordination unit with high level expertise in nutrition and physical activity monitoring to oversee data collection, analysis, interpretation and reporting, guided by
 - a steering committee comprising key funder(s) and jurisdictional stakeholders
 - a technical advisory group(s) comprising experts in food and nutrition monitoring and surveillance to provide advice on technical aspects of survey design, sampling, data collection and analysis, and reporting requirements
- a survey program with links to a biomedical survey program
- a food composition program, currently coordinated through FSANZ.

Under the proposed governance arrangements, a specialist agency could be contracted to manage and conduct the rolling survey program and relationships established with agencies that hold particular data, for example, FSANZ, ABS, and AIHW.

The system could be further enhanced by:

- integrating and harmonising state and territory key data collection systems
- specific time-limited strategic projects
- targeted surveys of specific population groups.



Data requirements

Masters and colleagues (2006) outlined the core data elements required for a comprehensive food and nutrition monitoring and surveillance system (Table 9.3). These elements could be expanded and built on over time. It is important that the data are:

- representative of the target group
- reproducible and valid
- not influenced by the method of administration
- consistent over time
- obtained by clearly defined standard methods (Rutishauser et al. 2007).

Food and nutrition monitoring requires clearly defined indicators (measurable statistical constructs) to assess progress towards a goal (Rutishauser et al. 2007). The indicator depends on the framework component. Examples could include the proportion of the population consuming recommended serves of fruit and vegetables, the proportion of the population who are overweight or obese, the proportion of the population who meet nutrient requirements, and breastfeeding prevalence. Up-to-date reference criteria are then required to interpret the findings, such as Australian Dietary Guidelines (NHMRC 2011), Nutrient Reference Values, targets and goals (NHMRC & NZMoH 2006).



Table 9.3: Core data elements of a food and nutrition monitoring and surveillance system

Framework component	Sub-component	Description
Food supply	Foodstuffs available for consumption	Food balance sheets for calculation of apparent consumption of foodstuffs ^(a)
	Food composition	Ongoing program of regular food composition data review and food analyses
Food purchase and acquisition	Changes in expenditure, types of food and quantities of food and price	Household expenditure data
	Food security	Access to nutritionally adequate, culturally appropriate food by members of the community
Food and physical activity behaviours	Continuous program of comprehensive dietary surveys	To include: • dietary assessment: - 24-hour multiple pass recall procedure followed by a second 24-hour recall conducted by telephone interview - food frequency questionnaire • physical activity: - short set of standard questions to classify individuals according to different levels of activity • demographic and anthropometric information: - description of population sub-groups and measured height, weight and waist circumference
	Short survey questions and modules on selected food and physical activity behaviours	Can be used in a wide range of survey vehicles, including CATI surveys and as part of existing health surveys Best mechanism would be including 6–10 questions on selected food behaviours in the comprehensive dietary survey program The same questions to be used over time and between surveys
Nutritional status	Anthropometrical measures	Height, weight and waist circumference
	Biological measures	Include biological measures in the on-going dietary survey program Criteria to guide selection of measures: • nutrients for which there is reliable evidence of inadequacy on a significant proportion of one or more population sub-groups • recognised risk factors for diet related chronic disease • nutrients of public health significance for which factors other than diet influence nutritional status • nutrients where there are problems in estimating appropriate/adequate intake from food intake data

(a) Considers annual production, changes in stocks, imports and exports, non-food uses, estimates of home production, loss in the supply chain.

Source: Masters et al. 2006.





Dissemination of information

To be of real value, the data collected through monitoring should be analysed and transmitted to decision makers in an appropriate and accessible format, and in a timely fashion. To ensure its ongoing usefulness, systems should be put in place for evaluation, feedback, and, where appropriate, comparison over time.

9.4 Existing data collections

While there is no endorsed food and nutrition monitoring and surveillance system in Australia, there are a number of current data collections that could make a contribution to a future formal system. These are listed below, along with recommendations for their ongoing applicability.

Food supply

Foods available for consumption

Food availability estimates provide an indication of the amount of food available for consumption by the population. The formula for the estimates takes into account the various factors that influence food availability, such as commercial production, imports, exports, non-food use and wastage. The data provide a useful mechanism for assessing trends in the food supply over time, both within and between countries (Rutishauser et al. 2007). It is important to note that these data do not depict actual consumption by the population and cannot replace food intake data. They do not take into consideration variables that affect access to food and food choices such as age, gender, ethnicity, income and geographical location.

Australian food statistics

Data related to food production, imports, exports, processing and domestic sales are published annually by the Australian Government Department of Agriculture, Fisheries and Forestry in *Australian food statistics* (DAFF 2012); however, these publications include less detail on the actual amount of food available for consumption than the earlier *Apparent consumption of foodstuffs* series. Some factors, such as wastage, may not be taken into account.

The discontinued *Apparent consumption of foodstuffs* series

From 1936 to 1999, the most important source of data on the food supply was the *Apparent consumption of foodstuffs* series published by the ABS (ABS 2000). This series provided a national inventory of domestic food supply and per capita consumption of selected foodstuffs, based on the formula in Box 9.1.

These data were used to monitor the nutritional adequacy of the food supply and trends in foods, food components, and foods as sources of nutrients, with data presented as 3-year averages. It is important to note that per capita consumption represents only the average amount of food available across the population, not foods consumed. The *Apparent consumption of foodstuffs* series is no longer produced.



Box 9.1: Formula for the calculation of apparent consumption of food

Apparent consumption =

(Commercial production + estimated home production + imports + opening stocks)

—

(Exports + usage for processed food^(a) + non-food use + wastage + closing stocks)

(a) Only where the processed food is included in apparent consumption data.

Source: ABS 1997.

Food balance sheets

The best alternative to the *Australian food statistics* series are the food balance sheet data, compiled by the FAO using their own methodology (FAO 2009a). Consumption in the food balance sheets refers to consumption at the household level, and the formula is similar to that used in the discontinued *Apparent consumption of foodstuffs* series.

These data, available for most countries including Australia, take into account the amount of food available for human consumption in a given year, expressed as kilograms of food per head of population per year (or grams per day). When assessing trends, these data are best presented as 3-year averages to allow for minor changes in food supply data collection methodology (Rutishauser et al. 2007).

Food composition

Up-to-date food composition data on Australian foods are necessary for calculating nutrient intakes. These data are used to calculate apparent and actual consumption of nutrients. FSANZ maintains Australia's food composition program and publishes two types of database:

- NUTTAB—a reference database in which the foods and nutrients vary according to the data available. The nutrient data are derived primarily from food analysis, with up to 160 nutrients listed per food. However, there are some incomplete data sets for foods.
- AUSNUT—survey-specific databases in which the foods vary according to those reported as consumed in each survey. The nutrient data for these foods are derived from a variety of methods and there is a complete data set for each food, typically between 30–40 nutrients per food.

To ensure the ongoing relevance of food composition databases, continual improvement is required to include new foods and reflect advances in analytical methods. This will ensure that accurate food composition data are available to enable the identification of trends in the nutrient composition of the food supply over time.

Food safety

FSANZ monitors the food supply in collaboration with other government agencies to ensure it is safe. Routine targeted surveys and Australian total diet studies collect analytical data on the levels of chemicals, microbiological contaminants and nutrients in food (FSANZ 2011d). The Communicable Disease Network Australia and OzFoodNet monitor incidents and outbreaks of foodborne disease to support a coordinated response to communicable disease outbreaks of national importance. More information on food safety is in Chapter 4.





Food purchasing

Changes in expenditure, types and quantities of food and price

The Household Expenditure Survey is a national survey conducted by the ABS to regularly collect information on expenditure, income and characteristics of households. It provides details on expenditure patterns on broad categories of goods, including food, and more detailed information on some items within these categories. These data allow for the determination of income allocated to food purchases in relation to other items and some monitoring of the trends in foods purchased by commodity groups.

However, Masters and colleagues (2006) highlight that data from the Household Expenditure Survey are underutilised for food and nutrition monitoring because it does not report quantities of food purchased and the descriptions of foods are not detailed enough to derive the nutrient content.

Food security

There has been a growing focus on factors that affect access to an affordable and nutritious food supply. However, there is limited national information on aspects of food access. As mentioned in Section 5.3, various jurisdictions undertake regular market basket surveys to monitor aspects of food security. Seal (2004) has recommended that a nationally coordinated food basket survey program be introduced to monitor the price and availability of healthy food.

Food and physical activity behaviours

A continuous program of comprehensive dietary surveys, including surveys of physical activity, is considered to be fundamental to a food and nutrition monitoring and surveillance system. Data on food habits or behaviours can be obtained through survey questions on the frequency, quantity and types of food usually consumed over a period of time, such as annually. More detailed information about total food and nutrient intake is best assessed through determining recent or current food consumption (Rutishauser et al. 2007).

Food consumption data

Data on usual food intakes and patterns of consumption are needed to assess the adequacy of the diet compared with food-based dietary guidelines (NZMoH 2003). Generally, there is no other way of determining food consumption other than surveying the population. For population surveys, food consumption data are generally collected via a food frequency questionnaire, a 24-hour recall, or both.

The food frequency questionnaire assesses habitual intake and includes questions about frequency and types of foods usually consumed over a period and, in some cases, the quantity of food usually consumed. It provides an estimate of usual food consumption patterns for the proportion of the population who consume a given food every day, a few times a week, a few times a month or less than monthly. Food frequency questionnaires are relatively quick and inexpensive to administer. However, they are hampered by a respondent's ability to recall their long-term average intakes accurately and to easily record seasonally consumed foods.

A 24-hour recall obtains information on food and fluid intake, and sometimes dietary supplements, from the previous 24 hours, thereby providing detailed information on total food and supplement consumption. This method can be used to determine quantitative estimates of food and supplement consumption and nutrient intakes can be calculated from food composition databases.





The 24-hour recall is relatively quick and inexpensive to administer and has a moderately low respondent burden compared with other methods, such as completing a food diary or food records. Respondents are also less likely to alter their usual food intake and are not required to be literate. However, this method has traditionally not accurately accounted for infrequently consumed foods and, like the food frequency questionnaire, poor memory can be a source of error.

In population surveys, there can be a wide range of reported intakes for some foods if records are for a single 24-hour recall only (Freedland et al. 2004). However, the width of the distribution can be reduced by collecting two or more days of 24-hour recall. If multiple records are collected for all individuals in the survey, an adjustment can be made for within person variation of food and nutrient intakes over multiple days (FSANZ 2009b).

Internationally, a new statistical method has recently been devised to estimate usual intakes of episodically consumed foods using information from two 24-hour recalls (Tooze et al. 2006). This new method, utilising logistic regression techniques, is an important advance from previous models and may replace the need to include food frequency questionnaires to capture usual intakes of episodically consumed foods.

Nutrient intake data

Nutrient intake data are needed to assess the adequacy of the diet compared with Nutrient Reference Values. Dietary nutrient intakes are determined by calculating the amount of food consumed (from food consumption surveys) together with data on the nutrient composition of these foods (from food composition databases), as represented by the equation in Box 9.2.

Box 9.2: Formula for the calculation of dietary nutrient intakes

Dietary nutrient intake = amount of food consumed × food nutrient concentration

It is also important to consider the contribution from dietary supplements when determining population nutrient intakes; these would also be queried during food consumption surveys.

Australian nutrition surveys

The first nutrition survey in Australia was undertaken by the Advisory Council on Nutrition in 1938 (see Box 9.3).

Box 9.3: First Australian nutrition survey

The results of the first Australian nutrition survey were reported in *The Canberra Times* under the headline 'Malnutrition stalks in Australia: six per cent of homes affected' (The Canberra Times 1938). The survey, which took 2 years, assessed the dietary habits of 8,957 Australians. The report found that Australians were generally well-fed generally; however, a minority were not able to obtain enough food. The Council recommended a higher intake of milk by:

- providing a daily milk supply for school children
- reducing the price of milk
- an educational campaign to ensure greater recognition of the value of milk.

It also recommended establishing a committee, to investigate and rectify nutritional inadequacies through a coordinated effort. A key recommendation was to ensure adequate nutritional health during infancy and childhood.



Since the early 1980s, Australia has conducted four national nutrition surveys:

- National Dietary Survey of Adults, 1983 (Commonwealth Department of Health 1986; Department of Community Services and Health 1987).
- National Dietary Survey of School Children (aged 10–15), 1985 (Department of Community Services and Health 1988, 1989).
- National Nutrition Survey, nutrient intakes and physical measurements, 1995 (ABS 1998, 1999).
- 2007 Australian National Children's Nutrition and Physical Activity Survey (CSIRO & University of South Australia 2008). This survey included physical activity, height and weight measures.

The methods used and information available differ between surveys; however, all examined foods consumed and the resultant nutrient intakes.

While the food consumption data from the 1995 National Nutrition Survey are dated, they have been combined with more up-to-date information by agencies such as FSANZ to provide an indication of present nutrient intakes, noting they do not account for changes in food consumption patterns that may have occurred since 1995.

The Victorian Government recently released the Victorian Population Health Survey 2009—an annual survey series to assess the health and nutritional status of adults living in Victoria. Food consumption data were obtained via three 24-hour recalls, undertaken 2 weeks apart using the computer-assisted telephone interview method. These provide data at a regional level (Victorian Department of Health 2011).

An Australian Health Survey Program began in 2011 and is due to finish in 2013. The program, when completed, will have surveyed a random sample of about 50,000 adults and children (aged 2 and over) from across Australia. A wide range of data are being collected, including food intake via 24-hour recall, physical activity, body measurements (height, weight and waist), blood pressure and (voluntary) biochemical measures for the assessment of nutrient status and chronic disease risk factors.

Four components of the 2011–2013 survey are:

- the National Health Survey
- the National Aboriginal and Torres Strait Islander Health Survey
- a National Nutrition and Physical Activity Survey
- a National Health Measures Survey.

Before 2011, the National Health Survey Program comprised only the National Health Survey and National Aboriginal and Torres Strait Islander Health Survey. Two new components have been added to the Australian Health Survey for 2011–2013. Data from the National Nutritional and Physical Activity Survey and the National Health Measures Survey (a biomedical collection) will provide nationally representative information on food and nutrition, physical activity and risk factors for chronic disease.

Health surveys with selected questions and modules on food and physical activity behaviours

Surveys are undertaken at the national and state/territory level to monitor the health status of the population. Food habits are often a component of these surveys; however, this is usually limited to a few short questions that have direct relevance to public health nutrition matters, such as fruit and vegetable intake and the type of milk consumed. Rutishauser and colleagues (2007) explain that to enable an assessment of changes in food habits over time, questions and responses must be standardised across surveys.



The National Health Survey is undertaken every 3–6 years using face-to-face interviews and collects nationally representative data on selected food habits (for example, fruit and vegetable consumption). The most recent surveys were conducted during 2007–08 for the general population (ABS 2009f), and during 2004–05 for the Aboriginal and Torres Strait Islander population (ABS 2006a). Health surveys (or similar) are also conducted in New South Wales, Victoria, Queensland, Western Australia, South Australia, and the Australian Capital Territory.

Some states and territories also collect data on food habits as part of their population health surveys, usually undertaken by the computer-assisted telephone interview approach. These include the New South Wales (NSW Department of Health 2008) and Victorian Population Health Surveys (Victorian Department of Health 2011) and the South Australian Monitoring and Surveillance System. Webb and colleagues (2006) comment that data on food habits assist with tracking change; however, such data are not a sufficient base on which to build food and nutrition policy.

Breastfeeding practices

Monitoring breastfeeding practices is important to determine if recommendations are being met. The 2010 Australian National Infant Feeding Survey was the first large-scale, specialised, national survey of infant feeding practices and related attitudes and behaviours conducted in Australia. The survey provided baseline data on the prevalence and duration of breastfeeding and other feeding practices adopted by mothers and carers (AIHW 2011d). At the time of publication, the *Infant feeding guidelines for health workers* are for future development.

The need for ongoing monitoring, research and evaluation to provide further insights into breastfeeding initiation and duration rates is acknowledged in the Australian Breastfeeding Strategy 2010–2015. As noted in Chapter 7, the development of six core breastfeeding indicators will ensure consistent, standardised measures are used for future monitoring. Further follow-up national infant feeding surveys will allow breastfeeding practices to be effectively monitored and assist in evaluating the current breastfeeding strategy.

Physical activity

When assessing nutritional adequacy, it is important to determine if energy requirements are being met or exceeded. Generally, energy balance is achieved when energy intake is equal to energy output. Therefore, information on physical activity is required for calculating energy requirements. The following national surveys have data on physical activity:

- 1999 National Physical Activity Survey (AIHW: Armstrong et al. 2000)
- 2007 Australian National Children's Nutrition and Physical Activity Survey (CSIRO & University of South Australia 2008)
- 2007–08 National Health Survey (ABS 2009f)
- 2011–2013 National Nutrition and Physical Activity Survey.

Nutritional status

If biological measures are collected in national surveys, they hold vital information for food and nutrition monitoring. However, assessing nutritional status through biological measures such as blood, urine and tissues has traditionally had lower practicality and acceptability than nutrition surveys (Rutishauser et al. 2007).

To date, national surveys have included limited nutrition-related biological measures. An exception was the National Iodine Nutrition Survey of schoolchildren in 2003–04 (Li et al. 2006; Li et al. 2008).





The 2011–2013 Australian Health Survey includes a voluntary biological measures component (for example, blood cholesterol, triglycerides, glucose, folate, B12, and urinary sodium, potassium and iodine). This National Health Measures Survey is intended to provide key information on the prevalence estimates of particular nutritional deficiencies (such as iron), and chronic conditions such as diabetes, cardiovascular disease and chronic kidney disease. It will also provide information on the dietary intake of nutrients for which food composition data are unreliable (such as vitamin D), or under-reported (such as sodium).

At the regional level, after the introduction of a voluntary iodine fortification program in Tasmania, urinary iodine was measured to assess the impact of the initiative (Hynes et al. 2004; Burgess et al. 2007; Seal et al. 2007). The 2009 Victorian Population Health Survey (Victorian Department of Health 2011) collected data for a range of biological measures, including folate and urinary iodine. Mandatory folic acid and iodine fortification has since been introduced in Australia, and steps have been put in place to monitor the effects (Box 9.4).

Biological measures are sometimes included in smaller nutrition research studies and these are often useful for identifying food and nutrition issues. Several similar studies can collectively contribute to a national nutrition monitoring and surveillance system and provide valuable information about specific subgroups or particular regions.

Box 9.4: Case study: Monitoring mandatory folic acid and iodine fortification

Mandatory folic acid and iodine fortification standards were introduced in Australia in September–October 2009. As a result, monitoring frameworks and program to determine their effects and effectiveness were developed.

The monitoring frameworks are based on an ‘outcomes hierarchy’ outlining the process, impact and outcome questions to be considered. When monitoring the standards it is essential to assess the positive effects on the target populations as well as any negative effects on the population as a whole. This has been outlined by FSANZ (FSANZ 2006, 2007c, 2008g) and is based on a model by Abraham & Webb (2001).

This outcomes hierarchy approach is based on a stepwise progression from the first action (the policy change) to the policy objective (the reduction in neural tube defects—NTDs, and iodine deficiency). Each step represents a measurable achievement necessary to achieve the next step and the ultimate outcome (Abraham & Webb 2001).

For example, an increase in the concentration of folic acid and iodine in the food supply should lead to an increase in nutrient intake, then status and ultimately a reduction in NTDs and iodine deficiency. Along with monitoring health benefits, it is essential that possible adverse health effects are assessed.

The monitoring frameworks for folic acid and iodine fortification are divided into five key components:

1. food composition/food industry compliance
2. nutrient intake
3. nutrient status
4. health benefits
5. adverse health effects.



Box 9.4 (continued): Case study: Monitoring mandatory folic acid and iodine fortification

Specific questions have been assigned to each component for both folic acid and iodine fortification, comprising:

- Has the level of folic acid and iodine in our food supply increased?
- Is the food industry adequately complying with the mandatory fortification standards?
- Have folic acid and iodine intakes increased in the target populations?
- Has the folate and iodine status in the target populations improved?
- Has the incidence of NTDs decreased and iodine deficiency been addressed?
- Does mandatory folic acid and iodine fortification result in adverse health effects for the population?

More details on the monitoring of mandatory folic acid and iodine fortification are in the baseline monitoring report (AIHW 2011g).

Anthropometry

Anthropometry is the study of human body measurements for comparative purposes and can be used as part of a nutritional assessment. These measurements can be used to compare weights with health reference standards and also growth in children. The following national surveys have collected anthropometric data:

- National Health Surveys
- Australian Diabetes, Obesity and Lifestyle Study
- Australian Diabetes, Obesity and Lifestyle follow-up study
- Australian Longitudinal Study on Women's Health (Women's Health Australia)
- National Aboriginal and Torres Strait Islander Health Survey
- National Nutrition Survey
- Australian Health and Fitness Survey
- Risk Factor Prevalence Surveys
- Household Income and Dynamics in Australia Survey
- Bettering the Evaluation and Care of Health
- Australian National Children's Nutrition and Physical Activity Survey
- Longitudinal Study of Australian Children (Growing up in Australia)
- Longitudinal Study of Indigenous Children (Footprints in Time)
- Adult Vaccination Survey
- Pandemic Vaccination Survey

A range of body weight variables have been collected (including both measured and self-reported measurements) such as height, weight, waist circumference and hip measurements. For further details on the various surveys, measurements collected and contact details see:

<www.aihw.gov.au/dataonline/obesity/body_weight_data_sources.xls> (AIHW 2010c).



Glossary

Note that terms in bold type in the definitions are themselves glossary items.

Aboriginal or Torres Strait Islander A person of Aboriginal and/or Torres Strait Islander descent who identifies as an Aboriginal and/or Torres Strait Islander. See also **Indigenous**.

aerobic A reaction or system that requires the presence of free oxygen.

anaemia A reduced level of haemoglobin, the protein that carries oxygen in the red blood cells. It has many causes, including bleeding (loss of red blood cells), low production of red blood cells, and processes that damage those red blood cells. It can cause paleness, tiredness and even breathlessness.

anaerobic A reaction or system that requires the absence of free oxygen.

antenatal The period covering conception up to the time of birth. Synonymous with **prenatal**.

anthropometric measurements Physical measurements of the human body including height, weight, and waist circumference.

anthropometry The study of human body measurements for comparative purposes. Can be used as part of a nutritional assessment.

apparent consumption A measure of the food supply available for human consumption after allowing for other uses and losses.

arable land Land that is suitable for growing crops.

basal metabolic rate (BMR) Represents the amount of energy expended at rest over a 24-hour period by an individual. The energy intake to BMR ratio provides an indication of whether the reported energy intake for one day is consistent with the energy intake required for a person to live a normal (not bed-bound) lifestyle.

biofortification A process where staple food crops are grown with enhanced micronutrient value either by breeding for higher uptake efficiency or fertilisation.

biotechnology A broad term used to describe the application of biology in industrial processes such as agriculture and food manufacture.

blood cholesterol Fatty substance produced by the liver and carried by the blood to supply the rest of the body. Its natural function is to supply material for cell walls and for steroid hormones, but if levels in the blood become too high, this can lead to hardening of the arteries and heart disease.

blood pressure The force exerted by blood against the walls of the arteries. The force is created by the pumping action of the heart, at contraction (systolic) and at relaxation (diastolic).

body mass index (BMI) The most commonly used method of assessing whether a person is normal weight, **underweight**, **overweight** or obese (see **obesity**). It is calculated by dividing the person's weight (in kilograms) by their height (in metres) squared; that is, $\text{kg} \div \text{m}^2$. For both men and women, underweight is a BMI below 18.5, acceptable weight is from 18.5 to less than 25, overweight is from 25 to less than 30, and obese is 30 and over. Sometimes overweight and obese is combined, and is defined as a BMI of 25 and over. This classification may not be suitable for children, older people and all ethnic groups.

broadacre A term used to describe farms or industries engaged in the production of grains, oilseeds and other crops, or the grazing of **livestock** on a large scale.



burden of disease and injury Term referring to the quantified impact of a disease or injury on an individual or population, using the disability-adjusted life year (DALY) measure.

cancer A large range of diseases whose common feature is that some of the body's cells become defective, begin to multiply out of control, can invade and damage the area around them, and can also spread to other parts of the body to cause further damage.

carbohydrate A major part of energy in human diets. Comprised of the elements carbon, hydrogen and oxygen, carbohydrates include starch, sugars and related substances (sugar alcohols and oligosaccharides).

cardiovascular disease Any disease of the circulatory system, namely the heart (cardio) or blood vessels (vascular). Includes heart attack, angina, stroke and peripheral vascular disease. Also known as circulatory disease.

cereals Types of grasses (such as wheat, rice or oats) cultivated for their edible grains.

cholesterol See **blood cholesterol**.

chronic diseases Term applied to a diverse group of diseases, such as heart disease, cancer and arthritis, which tend to be long-lasting and persistent in their symptoms or development. Although these features also apply to some communicable diseases (infections), the term is usually confined to **non-communicable diseases**.

climate change Long-term change in the statistical distribution of weather patterns over extended periods, ranging from decades to millennia.

convenience foods Packaged food that can be prepared quickly and easily.

diabetes (diabetes mellitus) A chronic condition in which the body cannot properly use its main energy source, the sugar glucose. This is due to a relative or absolute deficiency in insulin, a hormone produced by the pancreas that helps glucose enter the body's cells from the bloodstream and then be processed. **Diabetes** is marked by an abnormal build-up of glucose in the blood, and it can have serious short- and long-term effects.

dietary fibre Plant food components that pass through the stomach and small intestine undigested and reach the large intestine (colon) basically unchanged.

discretionary food Food that is additional to the five main food groups. They are not essential to provide nutrients the body needs and some contain too much fat, salt or sugar. These foods often contribute large amounts of energy. However, they can add to the enjoyment of eating a healthy diet, if eaten in moderation after the requirements of the other food groups have been met.

extra food See **discretionary food**.

fat Provides the most concentrated source of energy in the human diet, is a carrier for fat-soluble vitamins and is the source of essential fatty acids.

food fortification The deliberate addition of one or more micronutrients to correct or prevent a demonstrated deficiency and provide a health benefit.

food security Exists when all people at all times have access to sufficient, safe and nutritious food to maintain a healthy and active life.

Genetically Modified (GM) food Food whose genetic characteristics have been modified by inserting gene(s) from another organism using genetic engineering techniques.

HDL cholesterol Cholesterol packaged in high-density lipoprotein (HDL) particles. The HDLs are good acceptors of membrane-free cholesterol and transport it from tissues back to the liver (compare with **LDL cholesterol**).

incidence The number of new cases (of an illness or event, and so on) occurring during a given period. Compare with **prevalence**.

Index of Relative Socioeconomic Disadvantage One of the set of **Socio-Economic Indexes for Areas** for ranking the average socioeconomic conditions of the population in an area. It summarises attributes of the population such as low income, low educational attainment, high unemployment and jobs in relatively unskilled occupations.

Indigenous A person of Aboriginal and/or Torres Strait Islander descent who identifies as an Aboriginal and/or Torres Strait Islander. See also **Aboriginal or Torres Strait Islander**.

infant A child aged under 1 year.

LDL cholesterol Cholesterol packaged in low-density lipoprotein (LDL) particles. LDLs carry cholesterol to the various tissues for use (compare with **HDL cholesterol**).

legumes A plant in the family Fabaceae (or Leguminosae), or a fruit of these specific plants. Well-known legumes include beans, lentils, soy, peanuts and peas.

life expectancy An indication of how long a person can expect to live, depending on the age they have already reached. Technically, it is the number of years of life remaining to a person at a particular age if death rates do not change. The most commonly used measure is life expectancy at birth.

livestock Live animals including cattle, sheep and goats.

low birthweight Weight of a baby at birth that is less than 2,500 grams.

malnutrition A state that results from the body not getting the correct amount of nutrients.

mean The mean is the sum of observations divided by the number of observations.

median The midpoint of a list of observations that have been ranked from the smallest to the largest.

moisture (water) A major component of the human diet and body, and essential for excretion of waste products and regulation of body temperature. It may be consumed as part of a beverage or food, and it is also produced following the metabolism of macronutrients.

monitoring (of health) As used in this report, 'monitoring' refers to a process of keeping a continuous and close watch over important aspects of the public's health and health services through various measurements, and then regularly reporting on the situation, so the health system and society more generally can plan and respond accordingly. The term is often used interchangeably with surveillance, although surveillance may imply more urgent watching and reporting, such as the surveillance of infectious diseases and their epidemics. Monitoring can also be applied to individuals, such as hospital care where a person's condition is closely assessed over time.

nanotechnology The process of controlling the size and shape of materials at the atomic and molecular scale. The term generally applies to deliberately engineered matter less than 100 nanometres in size, much smaller than human cells, bacteria and viruses.

neural tube defects Serious birth defects such as spina bifida and anencephalus, caused by the incomplete formation of the neural tube during the first month of the baby's development in the womb.

non-communicable disease A disease that is non-infectious and non-transmissible.



non-Indigenous People who have declared they are not of Aboriginal or Torres Strait Islander descent. Compared with **Other Australians**.

novel food Non-traditional foods with no history of human consumption in Australia. Novel foods need thorough assessment by FSANZ, before they can be sold for consumption.

nutrients Key food components required for health and growth such as **protein, carbohydrates, fats, vitamins, minerals and water**.

obesity Marked degree of overweight, defined for population studies as a **body mass index** of 30 or over. See also **overweight**.

osteoporosis Thinning and weakening of the bone substance, with a resulting increase in risk of fracture.

Other Australians People who have declared they are not of Aboriginal or Torres Strait Islander descent, and those for whom their Indigenous status is unknown. Compare with **non-Indigenous**.

overweight Defined for the purpose of population studies as a **body mass index** of 25 or over. See also **obesity**.

pastoralism A division of farming related to the rearing of **livestock**.

policy Typically described as a principle or rule to guide decisions and achieve rational outcome(s).

prenatal The period covering conception up to the time of birth. Synonymous with **antenatal**.

prevalence The number or proportion (of cases, instances, and so forth) in a population at a given time. Compare with **incidence**.

protein Supplies essential amino acids and is also a source of energy. Protein can be supplied from animal or vegetable foods.

quintile A group derived by ranking the population of people or elements according to specified criteria and dividing it into five equal parts. The term can also mean the cut-points that make these divisions—that is, the 20th, 40th, 60th and 80th percentiles—but the first use is the more common one.

Relative Socioeconomic Disadvantage The **Index of Relative Socioeconomic Disadvantage** from the **Socio-Economic Indexes for Areas** (SEIFA) was used in this publication to report SES. The 1st **quintile** represents the most disadvantaged areas and the 5th **quintile** represents the least disadvantaged areas.

risk factor Any factor which represents a greater risk of a health disorder or other unwanted condition or event. Some risk factors are regarded as causes of disease, others are not necessarily so. Along with their opposites, protective factors, risk factors are known as determinants.

saturated fats Fats, most often of animal origin, that are solid at room temperature and whose fatty acid chains cannot incorporate additional hydrogen atoms. In excess, they tend to raise **blood cholesterol**.

serve size Sample serve sizes are defined and used for the food groups described in the *Australian guide to healthy eating* (Smith et al. 1998). Examples of several groups are summarised below.

Sample serves of bread, cereal, rice, pasta, noodles (about 600 kilojoules):

- 2 slices (60 grams) bread, 1 medium bread roll
- 1 cup (180 grams) cooked rice, pasta, noodles
- 1 cup (230 grams) cooked porridge
- 1½ cups (40 grams) of cereal flakes

Sample serves of vegetables, legumes (about 75–250 kilojoules):

- ½ cup (75 grams) cooked vegetables or legumes
- 1 cup salad vegetable
- 1 small potato

Sample serves of fruit (about 300 kilojoules):

- 150 grams of fruit (1 medium apple, banana, orange or pear, or two small apricots or plums)
- 1 cup (150 grams) diced pieces or canned fruit (for example, tinned peaches)
- 1½ tablespoons sultanas
- ½ cup (125 millilitres) fruit juice

Sample serves of milk, yoghurt or cheese (about 375–730 kilojoules):

- 1 cup (250 millilitres) milk
- 2 slices (40 grams) cheese
- 1 small carton (200 grams) yoghurt

Sample serves of meat, fish, poultry, eggs, nuts, legumes (about 600–850 kilojoules):

- ½ cup of lean mince, or 2 small chops, or 2 slices of roast meat (65–100 grams cooked meat)
- ½ cup (80 grams) of cooked legumes
- 80–120 grams of cooked fish fillet
- 2 small eggs
- ½ cup of nuts

Sample serves of extra foods are based on the amount that supplies 600 kilojoules:

- 1 (40 grams) doughnut
- 4 (35 grams) plain sweet biscuits
- 1 slice (40 grams) of cake

Socio-Economic Indexes for Areas A set of indexes, created from Census data, to represent the socioeconomic status of Australian communities and identify areas of advantage and disadvantage. The index value reflects the overall or average level of disadvantage of the population of an area; it does not show how individuals living in the same area differ from each other in their socioeconomic status. This report uses the **Index of Relative Socioeconomic Disadvantage** as an indication of how ‘well off’ a person or group is.

standard drink Any drink containing 10 grams of alcohol. One standard drink contains the same amount of alcohol regardless of container size or alcohol type (for example, beer, wine or spirits).

Standardised death rate Mortality within a given population is strongly related to age. Thus, a population with a large proportion of older persons would experience higher mortality rates than populations with a younger age profile. In order to facilitate comparisons between populations which may have different age structures, mortality rates within this publication have been directly age-standardised.

starch A complex **carbohydrate** made up of chains of simple sugar molecules. They are found mainly in seeds, fruits, tubers, roots and stem pith of plants, notably in corn, potatoes, wheat, and rice.

statistical significance An indication from a statistical test that an observed difference or association may be significant or ‘real’ because it is unlikely to be due just to chance. A statistical result is usually said to be ‘significant’ if it would occur by chance only once in twenty times or less often.



Torres Strait Islander A person of Torres Strait Islander descent who identifies as a Torres Strait Islander and is accepted as such by the community in which he or she lives.

Type 2 diabetes The most common form of **diabetes**, occurring mostly in people aged 40 or over, and marked by reduced or less effective insulin.

underweight Defined for population studies as a **body mass index** less than 18.5.

vegetarianism Diet based on foods derived from plant sources (for example, fruit, vegetables, nuts, grains and seeds) to the exclusion of meat products. Can be motivated by health, ecological and ethical concerns.

References

- AANA (Australian Association of National Advertisers) 2009. Food and beverages advertising and marketing communication code. Sydney: AANA.
- ABARES (Australian Bureau of Agricultural and Resource Economics and Sciences) 2001. Australian commodity statistics 2001. Canberra: ABARES.
- ABARES 2011. Australian commodity statistics 2011. Canberra: ABARES.
- ABARES 2012. Agricultural commodities: June quarter 2012. Canberra: ABARES.
- ABM (Australian Bureau of Meteorology) 2010a. Climate classification maps. Viewed 4 November 2010, <http://www.bom.gov.au/jsp/ncc/climate_averages/climate-classifications/index.jsp>.
- ABM 2010b. Australian climate variability and change—time series graphs. Viewed 3 January 2010, <<http://www.bom.gov.au/cgi-bin/climate/change/timeseries.cgi>>.
- ABM 2011. Climate statistics for Australian locations. Viewed 13 April 2011, <<http://www.bom.gov.au/climate/data/index.shtml?bookmark=200>>.
- Abraham B & Webb K 2001. Interim evaluation of the voluntary folate fortification policy. Canberra: Australian Food and Nutrition Monitoring Unit.
- ABS (Australian Bureau of Statistics) 1982. Apparent consumption of foodstuffs and nutrients Australia 1980–81. ABS cat. no. 4306.0. Canberra: Commonwealth of Australia.
- ABS 1990. Year book Australia 1990. ABS cat. no. 1301.0. Canberra: ABS.
- ABS 1997. Apparent consumption of foods and nutrients 1993–94, ABS cat. no. 4306.0. Canberra: ABS.
- ABS 1998. National Nutrition Survey, nutrient intakes and physical measurements, Australia, 1995. ABS cat. no. 4805.0. Canberra: ABS.
- ABS 1999. National Nutrition Survey, foods eaten, Australia, 1995. ABS cat. no. 4804.0. Canberra: ABS.
- ABS 2000. Apparent consumption of foodstuffs, Australia, 1997–98 and 1998–99. ABS cat. no. 4306.0. Canberra: ABS.
- ABS 2006a. Population distribution, Aboriginal and Torres Strait Islander Australians. ABS cat. no. 4705.0. Canberra: ABS.
- ABS 2006b. Household expenditure survey, Australia: detailed expenditure items, 2003–04 (reissue). ABS cat. no. 6535.0.55.001. Canberra: ABS.
- ABS 2008a. Australian historical population statistics, 2008. ABS cat. no. 3105.0.65.001. Canberra: ABS.
- ABS 2008b. Australian social trends 2008. ABS cat. no. 4102.0. Canberra: ABS.
- ABS 2008c. Year Book Australia, 2008. ABS cat. no. 1301.0. Canberra: ABS.
- ABS 2008d. Population projections Australia: 2006 to 2102. ABS cat. no. 3222.0. Canberra: ABS.
- ABS 2008e. Value of agricultural commodities produced. ABS cat. no. 7503.0. Canberra: ABS.
- ABS 2009a. Deaths, Australia, 2008. ABS cat. no. 3302.0. Canberra: ABS.
- ABS 2009b. Regional population growth, Australia, 2007–08. ABS cat. no. 3218.0. Canberra: ABS.
- ABS 2009c. Disability, Ageing and Carers, Australia: summary of findings: 2009. ABS cat. no. 4430.0. Canberra: ABS.

ABS 2009d. Children's participation in cultural and leisure activities, Australia. ABS cat. no. 4901.0. Canberra: ABS.

ABS 2009e. Environmental issues: waste management and transport use, March 2009. ABS cat. no. 4602.0.55.002. Canberra: ABS.

ABS 2009f. National Health Survey 2007–08: summary of results. ABS cat. no. 4364.0. Canberra: ABS.

ABS 2010. Australia's environment: issues and trends, 2010. ABS cat. no. 4613.0. Canberra: ABS.

ABS 2011a. Australian demographic statistics, June quarter 2011. ABS cat. no. 3101.0. Canberra: ABS.

ABS 2011b. Water account Australia, 2009–2010. ABS cat. no. 4610.0. Canberra: ABS.

ABS 2011c. Land management and farming in Australia. ABS cat. no. 4627.0. Canberra: ABS.

ABS 2011d. Australian industry, 2009–10. ABS cat. no. 8155.0. Canberra: ABS.

ABS 2011e. Agricultural commodities, Australia, 2009–10. ABS cat. no. 7121.0. Canberra.

ABS 2011f. Household Expenditure Survey, Australia: detailed expenditure items, 2009–10. ABS cat. no. 6530.0. Canberra: ABS.

ABS 2011g. Migration, Australia, 2009–10. ABS cat. no. 3412.0. Canberra: ABS.

ABS 2011h. Deaths, Australia, 2010. ABS cat. no. 3302.0. Canberra: ABS.

ABS 2012a. Causes of death, Australia, 2010. ABS cat. no. 3303.0. Canberra: ABS.

ABS 2012b. Methods, classifications, concepts & standards: frequently asked questions. Canberra: ABS. Viewed 7 June 2012, <<http://www.abs.gov.au/websitedbs/d3310114.nsf/home/frequently+asked+questions#Anchor7>>.

ABS 2012c. Year Book Australia, 2012. ABS cat. no. 1301.0. Canberra: ABS.

ABS 2012d. Labour force, Australia, detailed, quarterly, February 2012. ABS cat. no. 6291.0.55.003. Canberra: ABS.

ABS various. Consumer Price Index, Australia. ABS cat. no. 6401.0. Viewed 11 April 2012, <<http://www.abs.gov.au/ausstats/abs@.nsf/mf/6401.0>>.

ABS & Statistics NZ 2006. Australian and New Zealand standard industrial classification. ABS cat. no. 1292.0. Canberra: ABS.

ACARA (Australian Curriculum Assessment and Reporting Authority) 2012. Draft shape of the Australian curriculum: health and physical activity. Sydney: ACARA.

ACCC (Australian Competition and Consumer Commission) 2008. Report of the ACCC inquiry into the competitiveness of retail prices for standard groceries. Canberra: Commonwealth of Australia.

ACCC 2011. Country of origin claims and the Australian Consumer Law. Canberra: Commonwealth of Australia.

Access Economics 2008. The growing cost of obesity in 2008: three years on. Diabetes Australia. Viewed 5 August 2009, <<http://www.accesseconomics.com.au/>>.

ACHS (Australian Council on Healthcare Standards) 2012. ACHS Accreditation Programs. ACHS. Viewed 18 June 2012, <<http://www.achs.org.au/ACHSPrograms/>>.

ACHP (Australian Centre for Health Promotion) 2006. Food advertising on Sydney television: the extent of children's exposure. Sydney: ACHP.

ACIL Tasman 2008. Biotechnology and Australian agriculture. Canberra: Biotechnology Australia & DAFF.

ACOSS (Australian Council of Social Service) 2011. Poverty report: October 2011 update. Sydney: ACOSS.

ACTCOSS (ACT Council of Social Service) 2012. Community food guide: community food forum. Viewed 7 June 2012, <<http://www.actcoss.org.au/cfg/forum.html>>.

AFGC (Australian Food and Grocery Council) 2008. The responsible children's marketing initiative of the Australian food and beverage industry. Canberra: AFGC.

AFGC 2009. Towards sustainability 2007–08. Canberra: AFGC.

Ahmed F, Coyne T, Dobson A & McClintock C 2008. Iron status among Australian adults: findings of a population based study in Queensland, Australia. *Asia Pacific Journal of Clinical Nutrition* 17:40–7.

AIHW (Australian Institute of Health and Welfare) 2006. Chronic diseases and associated risk factors in Australia, 2006. Cat. no PHE 81. Canberra: AIHW.

AIHW 2008. Rural, regional and remote health: indicators of health status and determinants of health. Rural health series no. 9. Cat. no. PHE 97. Canberra: AIHW.

AIHW 2009. Aboriginal and Torres Strait Islander health performance framework 2008 report: detailed analyses. Cat. no. IHW 22. Canberra: AIHW.

AIHW 2010a. Premature mortality from chronic disease. AIHW bulletin no. 84. Cat. no. AUS 133. Canberra: AIHW.

AIHW 2010b. Australia's health 2010. Australia's health no. 12. Cat. no. AUS 122. Canberra: AIHW.

AIHW 2010c. National data sources for body weight. Viewed 6 October 2010, <http://www.aihw.gov.au/dataonline/obesity/body_weight_data_sources.xls>.

AIHW 2011a. Health expenditure Australia 2009–10. Cat. no. HWE 55. Canberra: AIHW.

AIHW 2011b. The health and welfare of Australia's Aboriginal and Torres Strait Islander people, an overview. Canberra: AIHW.

AIHW 2011c. Australia's welfare 2011. Australia's welfare no. 10. Cat. no. AUS 142. Canberra: AIHW.

AIHW 2011d. 2010 Australian National Infant Feeding Survey: indicator results. Cat. no. PHE 156. Canberra: AIHW.

AIHW 2011e. National breastfeeding indicators: workshop report. Cat. no. PHE 146. Canberra: AIHW.

AIHW 2011f. 2010 National Drug Strategy Household Survey report. Drug statistics series no. 25. Cat. no. PHE 145. Canberra: AIHW.

AIHW 2011g. Mandatory folic acid and iodine fortification in Australia and New Zealand: baseline data for monitoring. Cat. no. PHE 139. Canberra: AIHW.

AIHW 2012a. Australia's health 2012. Australia's health no. 13. Cat. no. AUS 156. Canberra: AIHW.

AIHW 2012b. Multiple risk factors contributing to chronic disease. Canberra: AIHW.

AIHW: Armstrong T, Bauman A & Davies J 2000. Physical activity patterns of Australian adults. Cat. no. CVD 10. Canberra: AIHW.

AIHW: Begg S, Vos T, Barker B, Stevenson C, Stanley L & Lopez A 2007. The burden of disease and injury in Australia 2003. Cat. no. PHE 82. Canberra: AIHW.

AIHW: Lester I 1994. Australia's food & nutrition. Canberra: AIHW.

AIHW: Li Z, Hilder L & Sullivan E 2011. Australia's mothers and babies 2009. Cat. no. PER 52. Adelaide: AIHW NISU.



AIHW: Coles-Rutishauser I & Lester I 1995. Plan for a national food and nutrition monitoring program (Food and Nutrition Monitoring Unit Working Paper 95.2). Canberra: AIHW.

Allen L, de Benoist B, Dary O & Hurrell R (eds) 2006. Guidelines on food fortification with micronutrients. Rome: World Health Organization.

APHDPC (Australian Population Health Development Principal Committee) 2007. The prevalence and severity of iodine deficiency in Australia: report to the Australian Health Ministers Advisory Council. APHDPC.

AHMC (Australian Health Ministers' Conference) 2009. The Australian National Breastfeeding Strategy 2010–2015. Canberra: Australian Government Department of Health and Ageing.

ANPHA (Australian National Preventative Health Agency) & SAH (South Australia Health) 2012. Communique: national seminar on food advertising and marketing to children, 9 May 2012. Adelaide: ANPHA and SAH.

Australian Egg Corporation Limited 2010. Annual report—from the farm to the table. Viewed 17 August 2011, <http://www.aecl.org/system/attachments/347/original/Annual_Report_2010.pdf?1289462015>.

Australian Farmers' Markets Association 2011. Viewed 20 November 2009, <<http://www.farmersmarkets.org.au/about.jsp>>.

Australian Government 2010. Taking preventative action—a response to Australia: the healthiest country by 2020—the report of the National Preventative Health Taskforce. Canberra: Australian Government.

Australian Government 2012a. Our people. Viewed 7 June 2012, <<http://australia.gov.au/about-australia/our-country/our-people>>.

Australian Government 2012b. Budget at a glance: 2012–13. Canberra: Commonwealth of Australia.

Australian Government 2012c. Stephanie Alexander kitchen garden national program. Viewed 7 June 2012, <<http://www.healthyactive.gov.au/internet/healthyactive/publishing.nsf/Content/kitchen-garden>>.

Australian Government Trade Commission 2010. Food and beverage—wholefoods/organics. Viewed 4 August 2010, <<http://www.austrade.gov.au/Buy/Australian-Industry-Capability/Food-and-Beverage/default.aspx>>.

Australian Parliament 2009. Weighing it up: obesity in Australia. Canberra: Commonwealth of Australia.

Baker D, Fear J & Denniss R 2009. What a waste: an analysis of household expenditure on food. Canberra: The Australia Institute.

Ball K, Timperio A & Crawford D 2009. Neighbourhood socioeconomic inequalities in food access and affordability. *Health & Place* 15:578–85.

Basiotis P & Lino M 2002. Nutrition insights: food insufficiency and prevalence of overweight among adult women. Alexandria, VA: USDA Center for Nutrition Policy and Promotion.

Better Health Channel 2012. Fats and oils. Viewed 22 June 2012, <http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/fats_and_oils>.

Binns C, Fraser ML, Lee A & Scott J 2009. Defining exclusive breastfeeding in Australia. *Journal of Paediatrics and Child Health* 45:174–80.

Biotechnology Australia 2005. Biofacts. Biotechnology Australia factsheet no. 1. Viewed 5 August 2010, <<http://www.biotechnology.gov.au>>.

BIS Shrapnel 2009. Fast food in Australia. Viewed 21 July 2010, <http://www.bis.com.au/verve/_resources/Fast_Food_extract.pdf>.

- Blewett N, Goddard N, Pettigrew S, Reynolds C & Yeatman H 2011. Labelling logic: review of food labelling law and policy (2011). Canberra: Australian Government Department of Health and Ageing.
- Booth S & Smith A 2001. Food security and poverty in Australia—challenges for dietitians. *Australian Journal of Nutrition and Dietetics* 58:150–6.
- Bove C, Sobal J & Rauschenbach B 2003. Food choices among newly married couples: convergence, conflict, individualism, and projects. *Appetite* 40:25–41.
- Bravo A & Cass Y 2003. Good food in family day care—improving nutrition and food safety in family day care: implementation and evaluation report. Sydney: South East Health Service.
- British Nutrition Foundation 2000. Nutrition and food processing (briefing paper). London: British Nutrition Foundation.
- Brown K, McIlveen H & Strugnell C 2000. Young consumers' food preferences within selected sectors of the hospitality spectrum. *Journal of Consumer Studies and Home Economics* 24:104–12.
- Brown L 2001. Eradicating hunger: a growing challenge. In: *State of the world 2001*. New York: WW Norton and Co.
- Brown L 2007. Biofuels blunder: massive diversion of US grain to fuel cars is raising world food prices, risking political instability. Testimony before US Senate Committee on Environment and Public Works. Viewed 29 November 2010, <http://www.earth-policy.org/press_room/C68/senateepw07>.
- Browne J, Laurence S & Thorpe S 2009. Acting on food insecurity in urban Aboriginal and Torres Strait Islander communities: policy and practice interventions to improve local access and supply of nutritious food. Viewed 15 June 2012, <<http://www.healthinonet.ecu.edu.au/health-risks/nutrition/other-reviews>>.
- Burgess J, Seal J, Stilwell G, Reynolds J, Taylor E & Parameswaran V 2007. A case for universal salt iodisation to correct iodine deficiency in pregnancy: another salutary lesson from Tasmania. *The Medical Journal of Australia* 186:574–6.
- Burns C 2004. A review of the literature describing the link between poverty, food insecurity and obesity with specific reference to Australia. Melbourne: Victorian Health Promotion Foundation.
- Burns C & Inglis A 2007. Measuring food access in Melbourne: access to healthy and fast foods by car, bus and foot in an urban municipality in Melbourne. *Health & Place* 13:877–85.
- Burns C, Jackson M, Gibbons C & Stoney RM 2002. Foods prepared outside the home: association with selected nutrients and body mass index in adult Australians. *Public Health Nutrition* 5:441–8.
- Burns J & Thomson N 2008. Review of nutrition and growth among Indigenous peoples. Viewed 28 June 2011, <<http://www.healthinonet.ecu.edu.au/health-risks/nutrition/reviews/our-review>>.
- Buzby J, Wells H, Axtman B & Mickey J 2009. Supermarket loss estimates for fresh fruit, vegetables, meat, poultry, and seafood and their use in the ERS loss-adjusted food availability data. Viewed 23 May 2011, <<http://www.ers.usda.gov/publications/eib44/eib44.pdf>>.
- Campbell A 2008. Managing Australia's soils: a policy discussion paper. Prepared for the National Committee on Soil and Terrain (NCST) through the Natural Resource Management Ministerial Council (NRMMC). Canberra: NRMMC.
- Campbell A 2009. Paddock to plate: policy propositions for sustaining food & farming systems. Melbourne: Australian Conservation Foundation.



- Cancer Council Australia 2008. How much sun is enough? Getting the balance right: vitamin D and sun protection (brochure). Viewed 14 June 2011,
< http://www.cancer.org.au/File/Cancersmartlifestyle/How_much_sun_is_enough_FINAL2012.pdf>.
- Cannon G & Leitzmann MF 2006. The new nutrition science project. *Scandinavian Journal of Food and Nutrition* 50(1):5–12.
- Cason K 2006. Family mealtimes: more than just eating together. *Journal of the American Dietetic Association* 106:532–33.
- Centre for Epidemiology and Research 2002. Child Health Survey 2001. *NSW Public Health Bulletin* 13:(S–4).
- Chang C, Griffith G & Zepeda L 2003. An overview of the organic food products market in Australia. Armidale: University of New England.
- Chen R, Lee M, Chang Y & Wahlqvist M 2012. Cooking frequency may enhance survival in Taiwanese elderly. *Public Health Nutrition* 2012 May 11:1–8.
- Choumenkovitch S, Jacques P, Nadeau M, Wilson P, Rosenberg I & Selhub J 2001. Folic acid fortification increases red blood cell folate concentrations in the Framingham study. *The Journal of Nutrition* 131:3277–80.
- Clarke W, Radnidge P, Lai E, Jensen P & Hardin W 2008. Digestion of waste bananas to generate energy in Australia. *Waste Management* 28:527–33.
- Clements F 1986. A history of human nutrition in Australia. Melbourne: Longman Cheshire.
- COAG (Council of Australian Governments) 2008a. National partnership agreement on closing the gap in Indigenous health outcomes. Canberra: COAG.
- COAG 2008b. National Partnership Agreement on Preventative Health. Canberra: COAG.
- COAG 2009. National strategy for food security in remote Indigenous communities. Canberra: COAG.
- Cole T, Bellizzi M, Flegal K & Dietz W 2000. Establishing a standard definition for child overweight and obesity worldwide; international survey. *British Medical Journal* 320(7244):1240–3.
- Cole T, Flegal K, Nichols D & Jackson A 2007. Body mass index cut offs to determine thinness in children and adolescents: international survey. *British Medical Journal* 335:194–202.
- Colmar Brunton Social Research 2007. Consumer use of nutrition content claims in shopping environments: research report. Viewed 24 May 2012,
<http://www.foodstandards.gov.au/_srcfiles/Instore%20Use%20of%20Nutrit.pdf>.
- Commonwealth Department of Health 1981. Dietary guidelines for Australians. *Journal of Food and Nutrition* 38:111–20.
- Commonwealth Department of Health 1986. National Dietary Survey of Adults: 1983. No. 1—foods consumed. Canberra: AGPS.
- Commonwealth Department of Health & Housing and Community Services 1992. Food and nutrition policy. Canberra: AGPS.
- Commonwealth Department of Health and Family Services 1998. Food and nutrition policy, summary report: the first three years. Canberra: Commonwealth of Australia.
- Cook T, Rutishauser I & Allsopp R 2001a. The bridging study: comparing results from the 1983, 1985 and 1995 Australian national nutrition surveys. Canberra: Commonwealth Department of Health and Aged Care.

Cook T, Rutishauser I & Seelig M 2001b. Comparable data on food and nutrient intake and physical measurements from the 1983, 1985 and 1995 national nutrition surveys. Canberra: Commonwealth Department of Health and Aged Care.

Cordell D, Drangert J & White S 2009. The story of phosphorus: global food security and food for thought. *Global Environmental Change* 19:292–305.

Cordell D, Rosemarin A, Schröder J & Smit A 2011. Towards global phosphorus security: a systemic framework for phosphorus recovery and reuse options. *Chemosphere* 84:758–70.

Cordell D & White S 2010. Securing a sustainable phosphorus future for Australia. *Farm Policy Journal* 7:1–17.

Coster M 2004. Report on the role of 'new generation' farmers' markets. Melbourne: Department of Primary Industries.

Coster M & Kennon N 2005. New generation farmers markets in rural communities. Rural Industries Research and Development Corporation Research Report, Publication 5:109.

Craig P & Truswell A 1994. Dynamics of food habits of newly married couples: who makes changes in the foods consumed? *Journal of Human Nutrition and Dietetics* 7:347–61.

CSIRO (Commonwealth Scientific and Industrial Research Organisation) 2007. Climate change in Australia. Canberra: CSIRO.

CSIRO 2008. An overview of climate change adaptation in Australian primary industries—impacts, options and priorities. Canberra: CSIRO.

CSIRO & University of South Australia 2008. 2007 Australian national children's nutrition and physical activity survey—main findings. Canberra: Commonwealth of Australia.

DAA (Dietitians Association of Australia) 2011. Smart eating for you. Viewed 9 June 2011, <<http://daa.asn.au/for-the-public/smart-eating-for-you/>>.

DAA 2012. Universities & recognition of qualifications. Viewed 31 May 2012, <<http://daa.asn.au/universities-recognition/>>.

DAFF (Department of Agriculture, Fisheries and Forestry) 2004. The Australian organic industry: a summary. Canberra: DAFF.

DAFF 2011. Issues paper to inform development of a national food plan. Canberra: DAFF.

DAFF 2012. Australian food statistics 2010–11. Canberra: DAFF.

Dairy Australia 2011. Industry statistics. Viewed 18 April 2011, <<http://www.dairyaustralia.com.au/Our-Dairy-Industry/Industry-Statistics.aspx>>.

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

Dangour AD, Dodhia SK, Hayter A, Allen E, Lock K & Uauy R 2009. Nutritional quality of organic foods: a systematic review. *The American Journal of Clinical Nutrition* 90:680.

Dangour AD, Lock K, Hayter A, Aikenhead A, Allen E & Uauy R 2010. Nutrition-related health effects of organic foods: a systematic review. *The American Journal of Clinical Nutrition* 92:203.

Darnton-Hill I, Nishida C & James W 2004. A life course approach to diet, nutrition and the prevention of chronic diseases. *Public Health Nutrition* 7:101–22.

Delange F 2000. The role of iodine in brain development. *Proceedings of the Nutrition Society* 59:75–9.



Delforce R, Dickson A & Hogan J 2005. Australia's food industry: recent changes and challenges. Vol. 2. Canberra: ABARE.

Department for Environment, Food and Rural Affairs (UK) 2005. The validity of food miles as an indicator of sustainable development: final report. London: Department for Environment, Food and Rural Affairs (UK).

Department for Environment, Food and Rural Affairs (UK) 2007. Report of the food industry sustainability strategy champion's group on waste. London: UK Government.

Department of Climate Change 2011. National greenhouse gas inventory accounting for Kyoto target. December quarter 2010. Viewed 23 June 2011, <<http://www.climatechange.gov.au/~media/publications/greenhouse-acctg/national-greenhouse-gas-inventory-accounting-december-quarter-2010.pdf>>.

Department of Climate Change and Energy Efficiency 2010. Australia's emissions projections 2010. Canberra, ACT: Department of Climate Change and Energy Efficiency.

Department of Community Services and Health 1987. National dietary survey of adults: 1983. No. 2—nutrient intakes. Canberra: AGPS.

Department of Community Services and Health 1988. National dietary survey of schoolchildren (aged 10–15 years): 1985. No. 1—foods consumed. Canberra: AGPS.

Department of Community Services and Health 1989. National dietary survey of schoolchildren (aged 10–15 years): 1985. No. 2—nutrient intakes. Canberra: AGPS.

Department of Health 2011. National diet and nutrition survey: headline results from years 1 and 2 (combined) of the rolling programme 2008/9–2009/10. Viewed 26 June 2012, <http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsStatistics/DH_128166>.

Department of Immigration and Citizenship 2009. More than 60 years of post-war migration. Viewed 28 June 2010, <<http://www.immi.gov.au/media/fact-sheets/04fifty.htm>>.

DEWHA (Department of the Environment, Water, Heritage and the Arts) 2009. National Waste Policy: less waste, more resources. Canberra: Commonwealth of Australia.

DEWHA 2009. Modernising irrigation. Viewed 1 July 2009, <<http://www.environment.gov.au/>>.

DEWHA 2010a. Securing our water future. Canberra: DEWHA.

DEWHA 2010b. National waste report 2010. Viewed 2 June 2011, <<http://www.environment.gov.au/settlements/waste/publications/pubs/fs-national-waste-report-2010.pdf>>.

DFAT (Department of Foreign Affairs and Trade) 2008a. A diverse people. Viewed 12 June 2009, <<http://www.dfat.gov.au/aib/society.html>>.

DFAT 2008b. Australia in brief. Ancient heritage, modern society. Viewed 28 June 2011, <<http://www.dfat.gov.au/aib/history.html>>.

DFAT 2008c. The Australian seafood industry. Viewed 19 April 2011, <<http://www.dfat.gov.au/facts/seafoodindustry.html>>.

DFAT 2011. Nauru country brief. Viewed 20 June 2011, <http://www.dfat.gov.au/geo/nauru/nauru_brief.html>.

DoHA (Department of Health and Ageing) 2003. Ministerial council policy guideline on the addition of caffeine to foods. Viewed 12 June 2012, <<http://www.health.gov.au/internet/main/publishing.nsf/Content/foodsecretariat-policy-guidelines>>.

DoHA & CSIRO 2008. Get set 4 life. Canberra: Commonwealth of Australia.

- DoHA 2009. The food regulation system. Viewed 16 April 2012, <<http://www.health.gov.au/internet/main/publishing.nsf/Content/foodsecretariat-system1.htm>>.
- DoHA 2010. National food incident response protocol. Viewed 12 June 2012, <<http://www.health.gov.au/internet/main/publishing.nsf/Content/foodsecretariat-isc-food.htm>>.
- DoHA 2011. Biomedical component of the Australian Health Survey: public health objectives. Viewed 6 June 2012, <[http://www.health.gov.au/internet/main/publishing.nsf/content/DB071AB4DF1917CCCA256F190004C168/\\$File/Biomedical%20component%20AHS-public%20health%20objectives.pdf](http://www.health.gov.au/internet/main/publishing.nsf/content/DB071AB4DF1917CCCA256F190004C168/$File/Biomedical%20component%20AHS-public%20health%20objectives.pdf)>.
- DoHA 2012. Nutrition and healthy eating. Viewed 2 May 2012, <<http://www.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-strateg-food-index.htm>>.
- Donnelly J 2011. The Irish famine, 17 February 2011. Viewed 4 April 2011, <http://www.bbc.co.uk/history/british/victorians/famine_01.shtml>.
- Drewnowski A & Specter S 2004. Poverty and obesity: the role of energy density and energy costs. *The American Journal of Clinical Nutrition* 79:6–16.
- EPHC (Environment Protection Heritage Council) 2009. National waste overview. Viewed 2 June 2011, <http://www.ephc.gov.au/sites/default/files/WasteMgt_Nat_Waste_Overview_PRINT_ver_200911.pdf>.
- Ericksen P 2008. Conceptualizing food systems for global environmental change research. *Global Environmental Change* 18:234–46.
- Ezzati M, Lopez A, Rodgers A & Murray CJ 2004. Comparative quantification of health risks: Global and regional burden of disease attributable to selected major risk factors. Geneva: WHO.
- Ezzati M, Lopez AD, Rodgers A, Vander Hoorn S & Murray CJ 2002. Selected major risk factors and global and regional burden of disease. *Lancet* 360:1347–60.
- FAO (Food and Agriculture Organization of the United Nations) 1995. Dimensions of need—an atlas of food and agriculture. Viewed 4 April 2011, <<http://www.fao.org/docrep/U8480E/U8480E00.htm>>.
- FAO 1996. Rome Declaration on World Food Security: the special program for food security. Rome: FAO.
- FAO 2002. Reducing poverty and hunger: the critical role of financing for food, agriculture and rural development. Rome: FAO.
- FAO 2008. Biodiversity to curb world's food insecurity. Viewed 2 February 2010, <<http://www.fao.org/newsroom/en/news/2008/1000841/index.html>>.
- FAO 2009a. FAOSTAT. Viewed 2 December 2009, <<http://faostat.fao.org/default.aspx>>.
- FAO 2009b. Declaration of the world summit on food security. Viewed 21 March 2012, <http://www.fao.org/fileadmin/templates/wsfs/Summit/Docs/Final_Declaration/WSFS09_Declaration.pdf>.
- FAO 2010. The state of food insecurity in the world. Viewed 5 November 2010, <<http://www.fao.org/publications/sofi/en/>>.
- FAO 2011a. From the green revolution to the gene revolution—how will the poor fare? Viewed 13 June 2012, <<ftp://ftp.fao.org/docrep/fao/008/af276e/af276e00.pdf>>.
- FAO 2011b. Global food losses and food waste. Extent, causes and prevention. Viewed 23 May 2011, <http://www.fao.org/fileadmin/user_upload/ags/publications/GFL_web.pdf>.
- FAO Fisheries Department 2005. Review of the state of world marine fishery resources. Rome: FAO.



Food Regulation Standing Committee 2011. Principles for introducing point-of-sale nutrition information at standard food outlets. Viewed 7 June 2012, <<http://www.health.gov.au/internet/main/publishing.nsf/Content/foodsecretariat-food-safety-pointofsale>>.

Foodbank 2012. Foodbank. An Australia without hunger. Viewed 7 June 2012, <<http://www.foodbank.com.au/>>.

FoodWise 2009. Food waste facts. Viewed 4 January 2010, <<http://www.foodwise.com.au/>>.

Franco S 2010. Obesity and the economics of prevention: fit not fat. Paris: Organisation for Economic Co-operation and Development.

Freedland SJ, Midthune D, Carroll R, Krebs-Smith SM, Subar A, Troiano RP et al. 2004. Adjustments to improve the estimation of usual dietary intake distributions in the population. *Journal of Nutrition* 134:1836–43.

Friel S, Marmot M, McMichael A, Kjellstrom T & Vagero D 2008. Global health equity and climate stabilisation: a common agenda. *The Lancet* 372:1677–83.

FSANZ (Food Standards Australia New Zealand) 2006. Final assessment report: proposal P295—consideration of mandatory fortification with folic acid. Canberra: FSANZ.

FSANZ 2007a. Trans fatty acids in the Australian and New Zealand food supply. Canberra: FSANZ.

FSANZ 2007b. First review report: proposal P295—consideration of mandatory fortification with folic acid. Canberra: FSANZ.

FSANZ 2007c. Final assessment report: proposal P230—consideration of mandatory fortification with iodine for New Zealand. Canberra: FSANZ.

FSANZ 2008a. Assessment of 2005 labels for key mandatory labelling elements for consistency against labelling provisions (phase 2 report). Viewed 1 September 2010, <<http://www.foodstandards.gov.au/newsroom/publications/evaluationreportseries/ongoingfoodlabelmoni3963.cfm>>.

FSANZ 2008b. Frequently asked questions on genetically modified foods. Viewed 12 November 2009, <<http://www.foodstandards.gov.au/foodmatters/gmfoods/frequentlyaskedquest3862.cfm/>>.

FSANZ 2008c. Small particles, nanotechnology and food (fact sheet). Canberra: FSANZ.

FSANZ 2008d. Melamine in foods from China (fact sheet). Canberra: FSANZ.

FSANZ 2008e. Consumer Attitudes Survey 2007. Canberra: FSANZ.

FSANZ 2008f. Application A577—Addition of calcium to ‘sugar-free’ chewing gum. Final assessment report. Viewed 6 June 2012, <<http://www.foodstandards.gov.au/foodstandards/applications/applicationa577addit3376.cfm>>.

FSANZ 2008g. Approval report: proposal P1003—mandatory iodine fortification for Australia. Canberra: FSANZ.

FSANZ 2008h. Standard 3.3.1—Food Safety Programs for Food Service to Vulnerable Persons. Viewed 18 June 2012, <<http://www.foodstandards.gov.au/foodstandards/foodsafetystandardsaustraliaonly/standard331foodsafet3808.cfm>>.

FSANZ 2009a. Review report: intakes of trans fatty acids in New Zealand and Australia—2009 assessment. Viewed 22 June 2012, <<http://www.health.gov.au/internet/main/publishing.nsf/Content/F5F93016C243672FCA2578A20019F090/%24File/Trans-Fatty-Acids-in-the-Australia-and-New-Zealand-Food-Supply%2520-%2520Att1.pdf>>.

FSANZ 2009b. Principles and practices of dietary exposure for food regulatory purposes. Canberra: FSANZ.

- FSANZ 2011a. Nanotechnology and food. Viewed 10 June 2012, <<http://www.foodstandards.gov.au/consumerinformation/nanotechnologyandfoo4542.cfm>>.
- FSANZ 2011b. Caffeine. Viewed 12 June 2012, <<http://www.foodstandards.gov.au/consumerinformation/caffeine/>>.
- FSANZ 2011c. Intense sweeteners (fact sheet). Viewed 6 June 2012, <<http://www.foodstandards.gov.au/scienceandeducation/factsheets/factsheets/intensesweeteners.cfm>>.
- FSANZ 2011d. The 23rd Australian total diet study. Canberra: FSANZ.
- FSANZ 2012a. About FSANZ. Viewed 16 April 2012, <<http://www.foodstandards.gov.au/scienceandeducation/aboutfsanz/>>.
- FSANZ 2012b. *Australia New Zealand Food Standards Code*. Melbourne: Anstat Pty Ltd.
- FSANZ 2012c. *Australia New Zealand Food Standards Code*—Standard 1.5.2—Food Produced using Gene Technology. Canberra: Commonwealth of Australia.
- FSANZ 2012d. AUSNUT 2007. Canberra: FSANZ. Viewed 13 June 2012, <<http://www.foodstandards.gov.au/consumerinformation/ausnut2007/>>.
- FSANZ 2012e. Food safety fact sheets. Viewed 12 June 2012, <<http://www.foodstandards.gov.au/scienceandeducation/factsheets/foodsafetyfactsheets/>>.
- FSANZ 2012f. Nutrition health and related claims. Viewed 24 May 2012, <<http://www.foodstandards.gov.au/consumerinformation/nutritionhealthandrelatedclaims/>>.
- FSIC (Food Safety Information Council) 2011. Food safety week. Viewed 12 June 2012, <<http://www.foodsafety.asn.au/foodsafetyweek/index.cfm>>.
- Gaballa S & Abraham A 2008. Food miles in Australia: a preliminary study of Melbourne, Victoria. Melbourne: CERES Community Environment Park.
- Gallegos D, Ellies P & Wright J 2008. Still there's no food! Food insecurity in a refugee population in Perth, Western Australia. *Nutrition and Dietetics* 65:78–83.
- Galli A & Esposti PD 2012. Slow food movement. Wiley-Blackwell Encyclopedia of Globalization.
- Garnaut R 2008. The Garnaut climate change review. Canberra: Cambridge University Press.
- Garnett T 2003. Wise moves: exploring the relationship between food, transport and CO₂. London: Transport 2000 Trust.
- Garnett T 2007. Food refrigeration: what is the contribution to greenhouse gas emissions and how might emissions be reduced? Food Climate Research Network. Viewed 12 May 2011, <<http://www.fcrn.org.uk/fcrn/publications/food-refrigeration-what-contribution-greenhouse-gas-emissions>>.
- Garnett T 2008. Cooking up a storm: food, greenhouse gas emissions and our changing climate. Canberra: Food Climate Research Network.
- Gaskill D, Black L, Isenring E, Hassall S, Sanders F & Bauer J 2008. Malnutrition prevalence and nutrition issues in residential aged care facilities. *Australasian Journal on Ageing* 127:189–94.
- Gibson R 2005. Principles of nutritional assessment. 2nd edn. New York: Oxford University Press.
- Gill T 2006. Epidemiology and health impact of obesity: an Asia Pacific perspective. *Asia Pacific Journal of Clinical Nutrition* 15 Supplement:3–14.



- Gill T, Baur L, Bauman A, Steinbeck K, Storlien L, Singh M et al. 2009. Childhood obesity in Australia remains a widespread health concern that warrants population-wide prevention programs. *Medical Journal of Australia* 190(3):146–8.
- Gillman M, Rifas-Shiman S, Frazier L, Rockett H, Camargo C, Field A et al. 2000. Family dinner and diet quality among older children and adolescents. *Archives of Family Medicine* 9:235–40.
- Gleadow RM, Edwards EJ & Evans JR 2009. Changes in nutritional value of cyanogenic trifolium repens grown at elevated atmospheric CO₂. *Journal of chemical ecology* 35:476–8.
- Gleck P 2009. The world's water 2008–2009: The biennial report on freshwater resources. Washington: Island Press.
- Glover J, Mewett O, Tifan M, Cunningham D, Ritman K & Morrice B 2005. What's in the pipeline? Genetically modified crops under development in Australia. Canberra: Bureau of Rural Sciences.
- Gracey M 2000. Historical, cultural, political, and social influences on dietary patterns and nutrition in Australian Aboriginal children. *The American Journal of Clinical Nutrition* 72:1361S.
- Griffin G, Sobal J & Lyson T 2009. An analysis of a community food waste stream. *Agriculture and Human Values* 26:67–81.
- Gunasekera D, Tulloh C, Ford M & Heyhoe E 2008. Climate change: opportunities and challenges in Australian agriculture. *Proceedings from the Faculty of Agriculture, Food and Natural Resources Annual Symposium*. Sydney: University of Sydney.
- Guthrie J, Guthrie A, Lawson R & Cameron A 2006. Farmers' markets: the small business counter-revolution in food production and retailing. *British Food Journal* 108:560–73.
- Harrison M, Coyne T, Lee A, Leonard D, Lowson S, Groos A et al. 2007. The increasing cost of the basic foods required to promote health in Queensland. *Medical Journal of Australia* 186(1):10–4.
- Harrison M, Lee A, Findlay M, Nicholls R, Leonard D & Martin C 2010. The increasing cost of healthy food. *Australian and New Zealand Journal of Public Health* 34:179–86.
- Heij EG 2005. Sustainability in the agrifood context—threat, opportunity, or something more? *Food Australia* 57:478.
- Hendrie G, Coveney J & Cox D 2008. Exploring nutrition knowledge and the demographic variation in knowledge levels in an Australian community sample. *Public Health Nutrition* 11:1365–71.
- Henry C & Heppell N 2002. Nutritional losses and gains during processing: future problems and issues. *Proceedings of the Nutrition Society* 61:145–8.
- Henzell T 2007. Australian agriculture: its history and challenges. Canberra: CSIRO.
- Hogan L & Thorpe S 2009. Issues in food miles and carbon labelling: ABARE research report 09.18. Canberra: Australian Bureau of Agricultural and Resource Economics.
- Holick MF 2004. Vitamin D: importance in the prevention of cancers, type 1 diabetes, heart disease, and osteoporosis. *The American Journal of Clinical Nutrition* 79:362–71.
- Horticulture Australia 2010. Commercial feasibility of banana waste utilization in the processed food industry. Viewed 5 June 2012, <http://www.horticulture.com.au/reports/search_final_reports_result.asp?src=&orgid=0&projid=4383&strSearch=&strProjectNo=BA09025&strIndustry=0-All&strSortby=date&strDisplay=titledesc&pageno=1>.
- Hughes R, Serebryanikova I, Donaldson K & Leveritt M 2011a. Student food insecurity: the skeleton in the university closet. *Nutrition & Dietetics* 68:27–32.

Hughes K, Christy A & Heimlich J 2011b. Bioreactor landfills. Ohio State University. Viewed 14 June 2011, <www.ohioline.osu.edu/cd-fact/pdf/0139.pdf>.

Humphreys J & Wakeman J 2008. Primary health care in rural and remote Australia: achieving equity of access and outcomes through national reform: a discussion paper. Canberra: National Health and Hospital Reforms Commission.

Hyder Consulting 2009. Waste and recycling in Australia. Viewed 23 May 2011, <<http://www.environment.gov.au/settlements/waste/publications/pubs/waste-recycling2009.pdf>>.

Hynes K, Blizzard C, Venn A, Dwyer T & Burgess J 2004. Persistent iodine deficiency in a cohort of Tasmanian school children: associations with socio-economic status, geographical location and dietary factors. *Australian and New Zealand Journal of Public Health* 28:476–81.

ICCIDD, UNICEF & WHO (International Council for the Control of Iodine Deficiency Disorders, the United Nations Children's Fund and the World Health Organization) 2007. Assessment of iodine deficiency disorders and monitoring their elimination. A guide for programme managers. 3rd edn. Viewed 14 September 2010, <http://whqlibdoc.who.int/publications/2007/9789241595827_eng.pdf>.

IFPRI (International Food Policy Research Institute) 2002. Green revolution: curse or blessing? Washington, DC: International Food Policy Research Institute.

Institute for Sustainable Futures 2005. Beyond recycling. An integrated waste management framework for local government. Viewed 12 May 2011, <<http://hdl.handle.net/10453/12095>>.

Institute of Medicine 2005. Food marketing to children and youth: threat or opportunity? Washington, DC: Institute of Medicine.

IPCC (Intergovernmental Panel on Climate Change) 2001. Climate change 2001: synthesis report. Contribution of working groups I, II, and III to the third assessment report of the intergovernmental panel on climate change. Cambridge: Cambridge University Press.

IPCC 2007a. Climate change 2007: synthesis report. Contribution of working groups I, II and III to the fourth assessment report of the Intergovernmental Panel on Climate Change. Geneva: IPCC.

IPCC 2007b. Climate change 2007: Impacts, adaptation and vulnerability: contribution of working group II to the fourth assessment report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.

James P 2006. Marabou 2005: nutrition and human development. *Nutrition Reviews* 64:S1–S11.

Janssen I, Craig W, Boyce W & Pickett W 2003. Associations between overweight and obesity with bullying behaviors in school-aged children. *Pediatrics* 113:1187–94.

Jones D, Hemphill W & Meyers E 1973. Height, weight and other physical characteristics of New South Wales Children. Part 1: children aged five years and over. Sydney: NSW Department of Health.

Jones T 2004. What a waste! interview. The science show, 19 April 2011. Viewed 19 April 2011, <<http://www.abc.net.au/rn/scienceshow/stories/2004/1256017.htm>>.

Kelleher K 2005. Discards in the world's marine fisheries—an update. Vol. ISBN 92-5-105289-1. Rome: FAO.

Kelly B, Bochynska K, Kornman K & Chapman K 2008a. Internet food marketing on popular children's websites and food product websites in Australia. *Public Health Nutrition* 11:1180–7.

Kelly B, Cretikos M, Rogers K & King L 2008b. The commercial food landscape: outdoor food advertising around primary schools in Australia. *Australian and New Zealand Journal of Public Health* 32:522–8.



- Kelly B, Hattersley L, King L & Flood V 2009. Smoke and mirrors: nutrient content claims used to market unhealthy food. *Nutrition & Dietetics* 69:62–3.
- Kelly B, Smith B, King L, Flood V & Bauman A 2007. Television food advertising to children: the extent and nature of exposure. *Public Health Nutrition* 10:1234–40.
- Kenny P 2000. The GST food exemption. *Journal of Australian Taxation*: 424–39.
- Kettings C, Sinclair A & Voevodin M 2009. A healthy diet consistent with Australian health recommendations is too expensive for welfare-dependent families. *Australian and New Zealand Journal of Public Health* 33:566–72.
- Klein S, Allison DB, Heymsfield SB, Kelley DE, Leibel RL, Nonas C et al. 2007. Waist circumference and cardiometabolic risk: a consensus statement from shaping America's health: Association for Weight Management and Obesity Prevention; NAASO, the Obesity Society; the American Society for Nutrition; and the American Diabetes Association. *The American Journal of Clinical Nutrition* 85:1197.
- Lahmann P, Wills R & Coory M 2009. Trends in birth size and macrosomia in Queensland, Australia, from 1988 to 2005. *Paediatric and Perinatal Epidemiology* 23:533–41.
- Lang T 2009. Reshaping the food system for ecological public health. *Journal of Hunger and Environmental Nutrition* 4:315–35.
- Lang T & Heasman M 2004. *Food wars: the global battle for mouths, minds, and markets*. London: Earthscan.
- Larson K, Ryan C & Abraham A 2008. Sustainable and secure food systems for Victoria: what do we know? What do we need to know? Victorian Eco-Innovation Lab. Melbourne: University of Melbourne.
- Lea E 2003. Meat and vegetarianism beliefs among Australians. *Journal of the Home Economics Institute of Australia* 10(1):19–28.
- Leggett B, Brown N, Bryant S, Duplock L, Powell L & Halliday J 1990. Factors affecting the concentrations of ferritin in serum in a healthy Australian population. *Clinical Chemistry* 36:1350–5.
- Legislative and Governance Forum on Food Regulation 2011. Response to the recommendations of labelling logic: review of food labelling law and policy. Canberra: Australia and New Zealand Food Regulation Ministerial Council.
- Li M, Eastman C, Waite K, Ma G, Zacharn M, Topliss D et al. 2006. Are Australian children iodine deficient? Results of the Australian national iodine study. *Medical Journal of Australia* 184:165–9.
- Li M, Eastman C, Waite K, Ma G, Zacharn M, Topliss D et al. 2008. Are Australian children iodine deficient? Results of the Australian national iodine nutrition study. Correction. *Medical Journal of Australia* 188:674.
- Lock K, Pomerleau J, Causer L, Altmann DR & McKee M 2005. The global burden of disease attributable to low consumption of fruit and vegetables: implications for the global strategy on diet. *Bulletin of the World Health Organization* 83:100–8.
- Lockie S, Lyons K, Lawrence G & Mummery K 2002. Eating 'green': motivations behind organic food consumption in Australia. *Sociologia Ruralis* 42:23–40.
- Lockie S & Peitsch J 2012. *Public opinion on food security*. Canberra: Australian National University.
- Lundqvist J, de Fraiture C & Molden D 2008. *Saving water: from field to fork—curbing losses and wastage in the food chain*. Huddinge, Sweden: SIWI.



Lyons G, Stangoulis J & Graham R 2004. Exploiting micronutrient interaction to optimize biofortification programs: the case for inclusion of selenium and iodine in the HarvestPlus program. *Nutrition Reviews* 62:247–52.

Magdoff F 2008. The world food crisis: sources and solutions. *Monthly Review*. Viewed 7 December 2010, <<http://www.monthlyreview.org/080501magdoff.php>>.

Malik S, Wong ND, Franklin SS, Kamath TV, L'Italien GJ, Pio JR et al. 2004. Impact of the metabolic syndrome on mortality from coronary heart disease, cardiovascular disease, and all causes in United States adults. *Circulation* 110:1245.

Margery A, Daniels L & Boulton T 2001. Prevalence of overweight and obesity in Australian children and adolescents: reassessment of the 1985 and 1995 data against new standard international definitions. *Medical Journal of Australia* 174:561–4.

Marmot M, Friel S, Bell R, Houweling T & Taylor S 2008. Closing the gap in a generation: health equity through action on the social determinants of health. *The Lancet* 372:1661–9.

Masters G, Coles-Rutishauser I, Webb K, Marks G & Pearse J 2006. National food and nutrition monitoring and surveillance system: a framework and a business case. Sydney: Nexus Management Consulting.

McCullough E, Pingali P & Stamoulis K 2008. Small farms and the transformation of food systems: an overview. In: E B McCullough, P Pingali & K Stamoulis (eds). *The transformation of agri-food systems: globalization, supply chains and smallholder farmers* Rome: FAO, 3–46.

McKenzie N & Dixon J 2006. Monitoring soil condition across Australia: recommendations from the expert panels. Canberra: National Land & Water Resources Audit.

McKenzie N, Jacquier D, Isbell R & Brown K 2004. *Australian soils and landscapes: an illustrated compendium*. Collingwood, Vic: CSIRO Publishing.

McMichael A 2005. Integrating nutrition with ecology: balancing the health of humans and biosphere. *Public Health Nutrition* 8:706–15.

McMichael A, Friel S, Nyong A & Corvalan C 2008. Global environmental change and health: impacts, inequalities, and the health sector. *British Medical Journal* 336:191–4.

Meat and Livestock Australia 2011. Australia's beef industry. Viewed 16 August 2011, <<http://www.mla.com.au/About-the-red-meat-industry/Industry-overview/Cattle>>.

Melbourne Institute of Applied Economic and Social Research 2011. *Poverty lines: Australia*. Melbourne: University of Melbourne.

Menzies School of Health Research 2008. *Nutrition improvement for Aboriginal people in remote townships*. Darwin: Menzies School of Health Research.

Metz J, Sikaris K, Maxwell E & Levin M 2002. Changes in serum folate concentrations following voluntary food fortification in Australia. *Medical Journal of Australia* 176:90–1.

Ministry of Health 2010. *The New Zealand health survey: objectives and topic areas* August 2010. Viewed 26 June 2012, <<http://www.health.govt.nz/publication/new-zealand-health-survey-objectives-and-topic-areas-august-2010>>.

Morgan E 2009. Fruit and vegetable consumption and waste in Australia. Viewed 2 June 2011, <http://www.vichealth.vic.gov.au/~/_/media/ResourceCentre/PublicationsandResources/healthy%20eating/FruitVegConsumptionWaste.ashx>.



Murphy B, Worcester M, Elliott P, Le Grande M, Higgins R & Goble A 2006. Change in women's dietary fat intake following an acute cardiac event: extent, predictors and comparison with non-cardiac Australian women and older adults. *European Journal of Cardiovascular Nursing* 5:206–13.

Myers R & Worm B 2003. Rapid worldwide depletion of predatory fish communities. *Nature* 423:280–3.

NARGA (National Association of Retail Grocers of Australia) 2010. The challenge to feed a growing nation. Viewed 18 August 2011, <http://www.narga.net.au/documents/2010/NARGA_lowres_web.pdf>.

National Center for Health Statistics 2012. National health and nutrition examination survey. Viewed 26 June 2012, <<http://www.cdc.gov/nchs/nhanes.htm>>.

National Food Authority 1993. Final report of the policy review. Canberra: AGPS.

National Institute for Public Health and the Environment 2012. Dutch national food consumption survey. Viewed 26 June 2012, <http://www.rivm.nl/en/Topics/Topics/D/Dutch_National_Food_Consumption_Survey>.

National Preventative Health Taskforce 2009a. Australia: the healthiest country by 2020. National preventative health strategy—the roadmap for action. Canberra: Commonwealth of Australia.

National Preventative Health Taskforce 2009b. Australia: the healthiest country by 2020. A discussion paper prepared by the National Preventative Health Taskforce. Canberra: Preventative Health Taskforce.

National Preventative Health Taskforce 2009c. Australia: the healthiest country by 2020: technical report no. 1. Obesity in Australia: a need for urgent action including addendum for October 2008 to June 2009. Canberra: Commonwealth of Australia.

National Restaurant Association 2011. Conserve solutions for sustainability. Viewed 1 June 2011, <<http://conserve.restaurant.org/issues/recycling.cfm>>.

National Water Commission 2007. Australian water resources 2005: a baseline assessment of water resources for the National Water Initiative. Key findings of the level 2 assessment. Canberra: National Water Commission.

NHF (National Heart Foundation) 1991. Risk factor prevalence study: iron status draft report. Canberra: NHF.

NHMRC (National Health and Medical Research Council) 2000. Nutrition in Aboriginal and Torres Strait Islander Peoples. An information paper. Canberra: NHMRC.

NHMRC 2003a. Dietary guidelines for Australian adults. Canberra: NHMRC.

NHMRC 2003b. Dietary guidelines for children and adolescents in Australia, incorporating the infant feeding guidelines for health workers. Canberra: NHMRC.

NHMRC 2009. Australian guidelines to reduce health risks from drinking alcohol. Canberra: Commonwealth of Australia.

NHMRC 2010a. A new food guidance system for Australia—foundation and total diets. Revised draft report for consultation. Viewed 15 August 2011, <<http://www.nhmrc.gov.au/guidelines/public-consultations/archived-public-consultations/draft-new-food-guidance-system-austral>>.

NHMRC 2010b. Iodine supplementation for pregnant and breastfeeding women. Viewed 4 May 2012, <<http://www.nhmrc.gov.au/your-health/nutrition>>.

NHMRC 2010c. Your health: nutrition. Viewed 25 October 2010, <http://www.nhmrc.gov.au/your_health/healthy/nutrition/index.htm>.

NHMRC 2011. Draft Australian dietary guidelines, incorporating the Australian guide to healthy eating (December 2011 version). Canberra: NHMRC.

NHMRC & NZMoH 2006. Nutrient Reference Values for Australia and New Zealand including Recommended Dietary Intakes. Canberra: Commonwealth of Australia.

NHPAC (National Health Priority Action Council) 2005. National chronic disease strategy. Canberra: DoHA.

Nicholas L, Pond D & Roberts D 2005. The effectiveness of nutrition counselling by Australian General Practitioners. *European Journal of Clinical Nutrition* 59 Supplement 1:S140–5; discussion S6.

Nielsen 2009. Grocery report 2008. Viewed 2 May 2011, <<http://au.nielsen.com/site/documents/nielsengroceryreport2008.pdf>>.

Nielsen 2011. 2011 state of the nation report: Retail World annual report. Viewed 10 March 2012, <http://au.nielsen.com/site/documents/RWSONDec2011final_doublepage.pdf>.

NLWRA (National Land and Water Resources Audit) 2001a. Australian agricultural assessment 2001. Vol. 1. Canberra: National Land & Water Resources Audit.

NLWRA 2001b. Australian agricultural assessment 2001. Vol. 2. Canberra: National Land & Water Resources Audit.

Nowson C 2006. Vitamin D status of Australians. *Nutrition & Dietetics* 63:194–5.

Nowson C & Margerison C 2002. Vitamin D intake and vitamin D status of Australians. *Medical Journal of Australia* 177:149–52.

NSW Department of Health 2008. New South Wales population health survey: 2005–2006 report on child health. Viewed 6 October 2010, <<http://www.health.nsw.gov.au/pubs/2008/pdf/childreport0506.pdf>>.

NSW Government and Office of Environment and Heritage 2010. Love food, hate waste. Viewed 9 June 2011, <<http://www.lovefoodhatewaste.nsw.gov.au/>>.

NSW Health 2011. Nutrition care policy. NSW Government. Viewed 18 June 2012, <http://www.health.nsw.gov.au/policies/pd/2011/pdf/PD2011_078.pdf>.

Nutrition Society of Australia 2012. Nutrition Society of Australia website. Adelaide: Nutrition Society of Australia. Viewed 31 May 2012, <<http://www.nsa.asn.au/>>.

NZMoH (New Zealand Ministry of Health) 2003. Food and nutrition monitoring in New Zealand. Wellington: NZMoH.

OECD (Organisation for Economic Co-operation and Development) 2007. Health at a glance: OECD indicators. Viewed 10 January 2012, <http://dx.doi.org/10.1787/health_glance-2011-en>.

Office of Legislative Drafting and Publishing 1999. *A New Tax System (Goods and Services Tax) Act 1999*. Canberra: Attorney-General's Department.

Office of Legislative Drafting and Publishing 2011. *Competition and Consumer Act 2010*. Canberra: Attorney-General's Department.

Olds T, Tomkinson G, Ferrar K & Maher C 2010. Trends in the prevalence of childhood overweight and obesity in Australia between 1885 and 2008. *International Journal of Obesity* 34:57–66.

OzHarvest 2012. OzHarvest food rescue. Viewed 3 May 2012, <<http://www.ozharvest.org/index.asp>>.

Paisley J, Beanlands H, Goldman J, Evers S & Chappell J 2008. Dietary change: what are the responses and roles of significant others? *Journal of Nutrition Education and Behavior* 40:80–8.

Parfitt J, Barthel M & Macnaughton S 2010. Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society* 365:3065–81.



- Patrick H & Nicklas T 2005. A review of family and social determinants of children's eating patterns and dietary quality. *Journal of the American College of Nutrition* 24:83–92.
- Patterson AJ, Brown W, Powers J, David C & Roberts C 2000. Iron deficiency, general health and fatigue: results from the Australian longitudinal study on women's health. *Quality of Life Research* 9:491–7.
- Pauly D 2006. Depletion of world fish stocks. Viewed 21 April 2011, <<http://www.abc.net.au/rn/scienceshow/stories/2006/1766715.htm>>.
- Pearson M & Lennon J 2010. Pastoral Australia: fortunes, failures and hard yakka. A historical overview 1788–1967. Collingwood: CSIRO Publishing.
- PHAA (Public Health Association of Australia) 2009. A future for food: addressing public health, sustainability and equity from paddock to plate. Canberra: Public Health Association of Australia.
- PHAA 2012. A future for food 2: healthy, sustainable, fair. Canberra: Public Health Association of Australia.
- PMSEIC (Prime Minister's Science, Engineering and Innovation Council) 2010. Australia and food security in a changing world. Canberra: The Prime Minister's Science, Engineering and Innovation Council.
- Poloczanska E & Richardson A 2009. Climate change. In: Poloczanska E, Hobday A & Richardson A (eds). A marine climate change impacts and adaptation report card for Australia 2009. Southport: National Climate Change Adaptation Research Facility.
- Polya R 2001. Food regulation in Australia—a chronology. Canberra: Commonwealth of Australia.
- Popkin B & Gordon-Larsen P 2004. The nutrition transition: worldwide obesity dynamics and their determinants. *International Journal of Obesity* 28:S2–S9.
- Prochaska L, Nguyen X, Donat N & Piekutowski W 2000. Effects of food processing on the thermodynamic and nutritive value of foods: literature and database survey. *Medical Hypotheses* 54:254–62.
- Productivity Commission 2005. Trends in Australian agriculture. Canberra: Productivity Commission.
- Productivity Commission 2006. Waste management, report no. 38. Canberra: Productivity Commission.
- Pyke J 1987. Australian health and fitness survey 1985. The fitness, health and physical performance of Australian school students aged 7–15 years. Adelaide: Australian Council for Health, Physical Education and Recreation Inc.
- Queensland Corrective Services 2009. Food and Nutrition Policy and Implementation Plan. Brisbane: Queensland Government.
- Queensland Health 2007. Nutrition policy for ATSIP community stores and take-aways. Brisbane: Queensland Health.
- Queensland Health 2011. The 2010 healthy food access basket (HFAB) survey. Brisbane: Queensland Government.
- Queensland Public Health Forum 2009. Eat Well Queensland: are we half way there yet? Midpoint implementation review summary of findings. Brisbane: Queensland Public Health Forum.
- Quine S & Morrell S 2006. Food insecurity in community-dwelling older Australians. *Public Health Nutrition* 9:219–24.
- Rama I & Lawrence P 2008. Food miles—a critical evaluation. Melbourne: Economics and Policy Research Branch, Victorian Department of Primary Industries.
- Rangan A, Randall D, Hector D, Gill T & Webb K 2008. Consumption of 'extra' foods by Australian children: types, quantities and contribution to energy and nutrient intakes. *European Journal of Clinical Nutrition* 62:356–64.

Rangan A, Schindeler S, Hector D, Gill T & Webb K 2009. Consumption of 'extra' foods by Australian adults: types, quantities and contribution to energy and nutrient intakes. *European Journal of Clinical Nutrition* 63:865–71.

Recycling Revolution 2011. Recycling facts. Viewed 14 June 2011, <<http://www.recycling-revolution.com/recycling-facts.html>>.

Reddy M & Love M 1999. The impact of food processing on the nutritional quality of vitamins and minerals. In: Jackson LS, MG K & JN M (eds). *The impact of food processing on food safety*. New York: Kluwer Academic/Plenum Publishers, 99–106.

Regmi A & Dyck J 2002. Effects of urbanization on global food demand in changing structure of global food consumption and trade. In: Regmi A (ed.). *Changing structure of global food consumption and trade*. Vol. WRS-01-1. Market Trade and Economics Division, Economic Research Service, United States Department of Agriculture, 23–30.

Renzaho A & Burns C 2006. Post-migration food habits of sub-Saharan migrants in Victoria: a cross-sectional study. *Nutrition & Dietetics* 63:91–102.

Retail World 2011. *Retail World's Australasian grocery guide 2011*. North Parramatta: Retail Media Pty Ltd.

Reynolds J 2006. School-based nutrition education—making it work. *Journal of the Home Economics Institute of Australia* 13:12–8.

Rickman J, Barrett D & Bruhn C 2007. Nutritional comparison of fresh, frozen and canned fruits and vegetables. Part 1. Vitamins C and B and phenolic compounds. *Journal of the Science of Food and Agriculture* 87:930–44.

Roy Morgan Research 2006. *Australian made campaign*. Melbourne: Roy Morgan Research.

Roy Morgan Research 2008. An investigation into the impact of nutrition content claims on packaging in relation to consumer purchase intention, nutrition attitude and health benefits. Viewed 24 May 2012, <http://www.foodstandards.gov.au/_srcfiles/P293_Attach_10_2_RMR.pdf>.

Roy Morgan Research 2009a. Online shopping growing, but not yet for Coles or Woolworths. Article no. 930. Melbourne: Roy Morgan Research.

Roy Morgan Research 2009b. 2009 Consumer survey attitudes towards logo and buying locally made. Viewed 20 June 2012, <<http://www.australianmade.com.au/research>>.

Rutishauser I 2000. *Getting it right: how to use the data from the 1995 National Nutrition Survey*. Canberra: Commonwealth of Australia.

Rutishauser I, Webb K, Abraham B & Allsopp R 2001. Evaluation of short dietary questions from the 1995 National Nutrition Survey. Canberra: AusInfo.

Rutishauser I, Webb K & Marks G 2007. Monitoring the food and nutrition situation of populations. In: Lawrence M & Worsley A (eds). *Public health nutrition: from principles to practice*. Crows Nest: Allen & Unwin.

Saethre E 2005. Nutrition, economics and food distribution in an Australian Aboriginal community. *Anthropological Forum* 15:151–69.

Scarborough P, Bhatnagar P, Wickramasinghe K, Allender S, Foster C & Rayner M 2011. The economic burden of ill health due to diet, physical inactivity, smoking, alcohol and obesity in the UK: an update to 2006–07 NHS costs. *Journal of Public Health* 33:527–35.



Schmidhuber J & Shetty P 2005. The nutrition transition to 2030. Why developing countries are likely to bear the major burden. Presented at the 97th Seminar of the European Association of Agricultural Economists, University of Reading, UK, 21–22 April, 2005. Viewed 24 June 2011, <http://www.fao.org/fileadmin/templates/esa/Global_persepctives/Long_term_papers/JSPStransition.pdf>.

Seal J 2004. Monitoring the price and availability of healthy food—time for a national approach? *Nutrition & Dietetics* 61:197–8.

Seal J, Doyle Z, Burgess J, Taylor R & Cameron A 2007. Iodine status of Tasmanians following voluntary fortification of bread with iodine. *Medical Journal of Australia* 186:69–71.

Seal J, Gall S, Taylor R & Venn A 2010. Folic acid fortification and folate status of Australian Women: nutrition monitoring implications: an Australian approach. Food Futures Conference, Canberra, 20–21 April 2010.

SecondBite 2012. SecondBite: Food for people in need. Viewed 3 June 2012, <<http://www.secondbite.org/>>.

SEI (Stockholm Environment Institute) 2005. Sustainable pathways to attain the Millennium Development Goals. Assessing the key role of water, energy and sanitation. Sweden: SEI.

Sensis 2009. Sensis consumer report, March 2009. Melbourne: Sensis & Sweeney Research.

SIGNAL 2001. Eat Well Australia: an Agenda for Action for Public Health nutrition. Canberra: Commonwealth of Australia.

Skinner J, Carruth B, Bounds W & Zeigler P 2002. Do food-related experiences in the first two years of life predict dietary variety in school-aged children? *Journal of Nutrition Education and Behavior* 34:3105–315.

Smith A, Kellett E & Schmerlaib Y 1998. The Australian guide to healthy eating. Canberra: Department of Health and Family Services.

Story M, Neumark-Sztainer D & French S 2002. Individual and environmental influences on adolescent eating behaviours. *Journal of the American Dietetic Association* 102:S40–51.

Stuart T 2009. Waste: uncovering the global food scandal. London: Penguin Press.

Sung KC & Ryu SH 2004. Insulin resistance, body mass index, waist circumference are independent risk factor for high blood pressure. *Clinical and Experimental Hypertension* 26:547–56.

Sustainability Victoria 2005. Waste wise catering. Viewed 1 June 2012, <http://www.resourcesmart.vic.gov.au/documents/ww_catering_toolkit.pdf>.

Symons M 2007. One continuous picnic. Melbourne: Melbourne University Press.

Tannahill R 1988. Food in history. London: Penguin Group.

Taylor G 1994. Landscapes of Australia: their nature and evolution. History of the Australian vegetation: Cretaceous to recent. Cambridge: Cambridge University Press.

Temple J 2008. Severe and moderate forms of food insecurity in Australia: are they distinguishable? *The Australian Journal of Social Issues* 43:649–68.

The Canberra Times 1938. Malnutrition stalks in Australia. 1–2.

The Giessen Declaration 2005. The Giessen Declaration. *Public Health Nutrition* 8:783–6.

The Walt Disney Company 2012. The Walt Disney Company set new standards for advertising to kids. Viewed 5 June 2012, <<http://thewaltdisneycompany.com/disney-news/press-releases/2012/06/walt-disney-company-sets-new-standards-food-advertising-kids>>.

Tilman D, Cassman K, Matson P, Naylor R & Polasky S 2002. Agricultural sustainability and intensive production practices. *Nature* 418.

TNS Social Research 2007. Qualitative research into the interpretation of %DI and %RDI labelling. Viewed 24 May 2012, <http://www.foodstandards.gov.au/_srcfiles/P293%20PFAR%20Att%202%20-%20Technical%20Report%20Consumer%20Research.pdf>.

Tooze JA, Midthune D, Dodd K, Freedman L, Krebs-Smith S, Subar A et al. 2006. A new statistical method for estimating the usual intake of episodically consumed foods with application to their distribution. *Journal of the American Dietetic Association* 106:1575–87.

Turrell G & Giskes K 2007. Socioeconomic disadvantage and the purchase of takeaway food: a multilevel analysis. *Appetite* 51:69–81.

Turrell G & Kavanagh A 2006. Socio-economic pathways to diet: modelling the association between socio-economic position and food purchasing behaviour. *Public Health Nutrition* 9:375–83.

UK Government Office for Science 2011. Foresight project on global food and farming futures. Synthesis report C7: reducing waste. Viewed 23 May 2011, <<http://www.bis.gov.uk/assets/bispartners/foresight/docs/food-and-farming/synthesis/11-627-c7-reducing-waste.pdf>>.

Ulrich A, Malley D & Voora V 2009. Peak phosphorus: opportunity in the making. Why the phosphorus challenge presents a paradigm for food security and water quality in the Lake Winnipeg Basin. Viewed 21 June 2011, <http://www.iisd.org/pdf/2010/peak_phosphorus.pdf>.

UN (United Nations) 2010a. The Millennium Development Goals report 2010. New York: UN.

UN 2010b. Biodiversity is life. Viewed 2 February 2010, <<http://www.cbd.int/2010/welcome/>>.

UN 2012. World urbanization prospects, the 2011 revision: frequently asked questions. Viewed 31 May 2012, <<http://esa.un.org/unpd/wup/Documentation/faq.htm>>.

UN Department of Economic and Social Affairs Population Division 2011. World population prospects: the 2010 revision. New York: UN.

UN Department of Economic and Social Affairs Population Division 2012. World urbanisation prospects: the 2011 revision. New York: UN.

UN Development Group 2010. Eradicate extreme poverty and hunger. Viewed 29 November 2010, <<http://www.undg.org/index.cfm?P=327>>.

UNEP (United Nations Environment Programme) 2007. Global environmental outlook 4: environment for development. Malta: Progress Press Ltd.

University of California Museum of Paleontology 2011. Monoculture and the Irish potato famine: cases of missing genetic variation. Viewed 4 April 2011, <http://evolution.berkeley.edu/evolibrary/article//agriculture_02>.

UNPF (United Nations Population Fund) 2007. State of World Population 2007. Unleashing the potential of urban growth. Viewed 21 June 2011, <http://www.unfpa.org/swp/2007/english/chapter_5/index.html>.

US Department of Energy 2010. Biomass program. Viewed 29 November 2010, <<http://www1.eere.energy.gov/biomass/sustainability.html>>.

US Geological Survey 2012. Mineral commodity summaries 2012. Reston, Virginia: US Geological Survey.

VVSQ (Vegetarian/Vegan Society of Queensland Incorporated) 2010. A pound of flesh. Viewed 2 July 2012, <<http://www.scribd.com/doc/26880337/APF-VVSQ>>.



VicHealth (Victorian Department of Health) 2008. Food for all: how local government is improving access to nutritious food. Melbourne: VicHealth.

Victorian Department of Health 2011. Victorian Population Health Survey 2009. Melbourne: State Government of Victoria.

Vos DT & University of Queensland Centre for Burden of Disease and Cost-Effectiveness 2007. The burden of disease and injury in Aboriginal and Torres Strait Islander peoples 2003. Brisbane: Centre for Burden of Disease and Cost-Effectiveness, School of Population Health, University of Queensland.

Wahlqvist M 1983. Food and nutrition in Australia. NSW: Methuen Australia Ltd.

Wake M, Hesketh K & Waters E 2003. Television, computer use and body mass index in Australian primary school children. *Journal of Paediatrics and Child Health* 39:130–4.

WALGA (WA Local Government Association) 2009. Alternative waste treatment (AWT) technology discussion paper. Viewed 14 June 2012, <http://www.wastenet.net.au/policy/reports/awtpaper/file/at_download>.

Walpole S, Prieto-Merino D, Edwards P, Cleland J, Stevens G & Roberts I 2012. The weight of nations: an estimation of adult human biomass. *BMC Public Health* 12:439.

Wastenet 2006. Waste disposal. Viewed 15 June 2011, <http://www.wastenet.net.au/information/hierarchy/recovery/pyrolysis_gasification>.

Water Footprint Network 2011. Water footprint calculator. Viewed 11 April 2011, <<http://www.waterfootprint.org/?page=files/home>>.

Webb KL, Rutishauser I, Marks G, Masters G & Leeder S 2006. Nutrition surveys or surveillance: one-night stands or a long-term commitment? *Medical Journal of Australia* 185:248–9.

White A, Gallegos D & Hundloe T 2011. The impact of fresh produce specifications on the Australian food and nutrition system. *Journal of Public Health Nutrition* 14(8):1489–95.

Whitehead M 1992. The concepts and principles of equity and health. *International Journal of Health Services* 22:429–45.

WHO (World Health Organization) 1992. International classification of diseases and related health problems: 10th revision. Geneva: WHO.

WHO 2000. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. WHO technical report series 894. Geneva: WHO.

WHO 2001. Iron deficiency anaemia: assessment, prevention and control. A guide for programme managers. Viewed 14 June 2012, <http://www.who.int/nutrition/publications/en/ida_assessment_prevention_control.pdf>.

WHO 2002. The world health report 2002: reducing risks, promoting healthy life. Geneva: WHO.

WHO 2003. Diet, nutrition and the prevention of chronic diseases. WHO technical report series 916. Geneva: WHO.

WHO 2004a. Marketing food to children: the global regulatory environment. Geneva: WHO.

WHO 2004b. WHO global strategy on diet, physical activity and health (endorsed by the 57th World Health Assembly). Geneva: WHO.

WHO 2006. Fact sheet no. 311—Obesity and overweight. Viewed 5 November 2010, <<http://www.who.int/mediacentre/factsheets/fs311/en/print.html>>.

- WHO 2008a. 2008–2013 Action Plan for the Global Strategy for the Prevention and Control of Noncommunicable Diseases. Viewed 1 July 2012, <<http://www.who.int/nmh/publications/9789241597418/en/index.html>>.
- WHO 2008b. Indicators for assessing infant and young child feeding practices. Part 1: definitions. Conclusions of a consensus meeting held 6–8 November 2007 in Washington, DC, USA. Geneva: WHO.
- WHO 2009. Global health risks: mortality and burden of disease attributable to selected major risks. Geneva: WHO.
- WHO 2010. Set of recommendations on the marketing of foods and non-alcoholic beverages to children. Geneva: WHO.
- WHO & UNICEF 2012. Water, sanitation and hygiene. Viewed 31 May 2012, <<http://www.unicef.org/wash/>>.
- Williams P 2009. Foodservice perspective in institutions. Wollongong: University of Wollongong.
- Williams P, Stirling E & Keynes N 2004. Food fears: a national survey on the attitudes of Australian adults about the safety and quality of food. *Asia Pacific Journal of Clinical Nutrition* 13:32–9.
- Woolcott Research 2007. Evaluation of the national *Go for 2&5* campaign. Sydney: Woolcott research.
- Woolworths 2011. Environmental commitment. Viewed 28 May 2012, <<http://www.woolworths.com.au/wps/wcm/connect/Website/Woolworths/About+Us/Our+Planet/>>.
- Working Group of the Australian and New Zealand Bone and Mineral Society Endocrine Society of Australia & Osteoporosis Australia 2005. Vitamin D and adult bone health in Australia and New Zealand: a position statement. *Medical Journal of Australia* 182:281–5.
- World Bank Agriculture and Rural Development Department 2004. Saving fish and fishers. Toward sustainable and equitable governance of the global fishing sector. Washington: The World Bank Agriculture and Rural Development Department.
- Worm B, Barbier E, Beamont N, Duffy J, Folke C, Halpern B et al. 2006. Impacts of biodiversity loss on ocean ecosystem services. *Science* 314:787–90.
- Worsley A 1988. Cohabitation-gender effects on food consumption. *International Journal of Biosocial Research* 10:107–22.
- WRAP (Waste and Resources Action Programme) 2008. The food we waste. Viewed 6 June 2011, <<http://wrap.s3.amazonaws.com/the-food-we-waste-executive-summary.pdf>>.
- WRAP 2009. Household food and drink waste in the UK. Banbury: WRAP.
- WRAP 2010. A review of waste arising in the supply of food and drink to UK households. Banbury: WRAP.
- Zhai F & Zhuang J 2009. Agricultural impact of climate change: a general equilibrium analysis with special reference to Southeast Asia. Viewed 21 June 2011, <<http://www.adbi.org/working-paper/2009/02/23/2887.agricultural.impact.climate.change/>>.

