Understanding Australian red meat's role in the future of health and wellness

Report prepared by Food & Nutrition Australia

For further information:

Sharon Natoli
Director and Accredited Practising Dietitian
Food & Nutrition Australia

T: 02 9262 1211
E: snatoli@foodnut.com.au
foodnut.com.au

Table of contents

Executive summary

Red meat (beef, lamb and goat) is a nutrient rich food, providing high quality protein, at least eight different vitamins and minerals, a variety of bioactive substances, choline and omega-3s making it a valuable food as part of a healthy diet. The nutritional status of red meat is recognised both locally and globally in government dietary guidelines and policy documents and the Food & Agricultural Organisation (FAO) recognises the important role red meat plays in meeting future global nutritional needs.

Consumption trends vary by country with key influencers being income, culture and religion, and perceptions about the role red meat plays in health and wellness. In some markets red meat consumption is increasing and in others, it is in slight decline.

Maintaining or increasing red meat intake through future marketing and innovation strategies that target health and wellness can assist in addressing local and global health and nutrition issues, including under-nutrition, malnutrition and overweight and obesity. It is also essential for the long-term sustainability and prosperity of the industry.

Consumer demands around food, and the expectations they have of the role food plays in health and nutrition, continue to change and evolve. Increasingly, consumers are looking for food to do more than simply meet daily nutrient and energy needs. They are seeking out 'functional foods' that help them solve daily challenges, such as managing weight, supporting immunity and helping ward off the signs of ageing or the development of lifestyle related diseases.

While interest in functional foods is strong, it exists alongside consumer desire to preference 'fresh' and 'natural' foods to improve health and wellbeing. Emerging research identifying the health risks associated with high consumption of ultra-processed foods is propelling this desire further.

With its high-quality protein, natural and fresh status, and strong nutritional profile, red meat is well positioned to provide foods that meet these needs.

As a result of the research and analysis outlined in this report, three top priority areas for innovation by the industry are identified, along with three second tier opportunities. These are linked to the areas of immune health, weight management, healthy longevity, sports performance, skin and joint health. A number of other high-level recommendations are made to provide the basis of a future ready health and wellness strategy.

The natural nutritional value of red meat, along with its content of bioactive substances, provides a ready platform for innovation that will assist the industry take advantage of the expanding USD1.8 trillion health and wellness market both now and into the future. This report provides a starting point for further discussion, prioritisation and action.

Introduction

Local and global markets are facing nutritional challenges connected to the mega-trends of escalating rates of overweight and obesity, the double burden of malnutrition and chronic disease, and an ageing population. Concurrently, technology and nutrition science are advancing in a way that enables greater access to personalised nutrition, a deeper understanding of the components of food that confer health benefits and the ability to map genes that code for diet related illnesses and susceptibilities, along with identification of the nature of an individual's microbiome and linking this to health, disease and cognitive functioning.

Similarly, consumers are looking for foods that perform functions beyond simply meeting daily nutritional needs and are seeking ways to optimise health and wellbeing now and preserve this into the future.

Given the nutritional profile of red meat, its spectrum of bioactive components, versatility and accessibility, it can play a crucial role in helping address future health, wellness and nutritional challenges faced by individuals, populations and governments. It also provides a platform for industry innovation that meets the changing and evolving needs of consumers.

This report highlights the nutritional profile of red meat and its bioactive components, with a focus on beef, lamb, goatmeat and offal and identifies how these nutritional attributes serve to meet changes in consumer behaviour, provide a solution for local and global health and wellness issues, and address nutritional concerns connected with an aging population.

The report also identifies opportunities for innovation, including possibilities for new product formats, marketing and communications. An understanding across these areas provides the red meat industry with the beginnings of a future ready health and wellness strategy that enables producers to take advantage of the USD1.8 trillion global health and wellness market.

> **"The future depends on what we do in the present."**
>
> **– Gandhi**

Notes:

Throughout the report, a standard amount of 150g raw meat (beef, lamb and goat) and 100g offal is used as the reference quantity when communicating about the nutrient content of meat.

Section 1 – The role of red meat in health and nutrition

Global health trends

Major health and nutrition challenges relevant to red meat covered in this section:

1. Obesity and overweight
2. Diet related diseases
3. Malnutrition

Obesity and overweight

Overweight and obesity is a global epidemic. One in eight people in the world are living with obesity, prevalence in adults has more than doubled since 1990, and quadrupled in adolescents[1].

More people now live in countries where overweight and obesity is responsible for greater mortality than underweight and this trend is expected to continue.

Locally, Australia ranks tenth out of 21 OECD countries for the proportion of people aged 15 and over living with overweight or obesity[2]. Currently, 66% of Australian adults and 26% of children aged 2–17 years are overweight or obese[3]. Concerningly, two in three Australians who are overweight are also malnourished[4].

Future trends

By 2035, over half the world's population will be overweight or obese[5]. All world regions will be affected, particularly low and middle-income countries, where urbanization and the adoption of Western style diets are accelerating. Table 1 shows the projections across regions.

As indicated, the Western Pacific region is the area predicted to have the most people affected by 2035. This region includes Australia, China, Fiji, Japan, Malaysia, New Zealand, Singapore, South Korea, Vietnam and others. This is followed by the Southeast Asian region which includes India, Indonesia, Sri Lanka, Thailand and others.

In Australia specifically, adult obesity is predicted to rise from 31.7% in 2022–23 to 47% by 2035, representing a 2.2% annual increase. Among children the projected increase is 2.6% annually[6].

Obesity increases the risk of a range of non-communicable diseases (NCDs), including cardiovascular diseases, diabetes, and certain cancers, all predicted to continue to grow over coming decades. Rapid increases in the risk factors for NCDs (high blood glucose levels, high blood pressure and low levels of good cholesterol) will also occur in children[5].

Economic impact

By 2035, the global economic impact of obesity will more than double, rising from just under USD2 trillion[7] in 2020 to USD4.32 trillion annually due to increased healthcare costs and reduced productivity[1].

The economic impact of obesity in Australia will rise from $8.6 billion annually up to $13–21 billion by 2030 and reach $88 billion by 2060[7] with productivity losses contributing to an overall GDP reduction of up to $87.7 billion by 2060[8].

Policy implications

Governments and health related organisations have responded to the extensive impact of escalating rates of overweight and obesity. The World Health Organisation's (WHO) Global Action Plan covering 2013–2030 aims for a 25% reduction in prevalence by 2025, primarily by encouraging countries to take action to reduce unhealthy diets and/or promote healthy diets[9].

Locally, the Australian Federal Government has two key preventative strategies in place to address overweight and obesity up to 2032[10,11]. Both aim to halt the rise and reverse the trend by at least 5% by 2030.

Diet related diseases

Poor diet is a leading risk factor for death and disability globally accounting for 11 million deaths annually[12]. This includes conditions such as heart disease, stroke, type 2 diabetes, certain cancers and obesity-related conditions, such as metabolic syndrome and liver disease.

In Australia, diet related risk factors contribute to around 10% of deaths annually[13] (after tobacco use and overweight and obesity). A snapshot of the present state and future predictions for diet related diseases is depicted in Figure 1.

Table 1 Projections in prevalence of overweight and obesity across regions

Region	Prevalence rates			
	2020	2025	2030	2035
African region	35%	39%	43%	47% (386 million)
Eastern Mediterranean region	51%	54%	57%	61% (359 million)
European region	63%	66%	68%	71% (509 million)
Region of the Americas	67%	71%	74%	77% (639 million)
South East Asia region	26%	30%	34%	39% (608 million)
Western Pacific region	36%	41%	46%	51% (793 million)

Global

	Heart disease Heart diseases will remain the leading cause of death globally. Hypertension and high cholesterol are expected to be key drivers.
	Diabetes Type 2 diabetes will increase in adults from 537 million today to 643 million by 2030 and 783 million by 2045.
	Cancers Diet is responsible for up to 30% of all cancer cases in Western countries. This figure will rise as more countries adopt unhealthy dietary patterns.
	Dementia By 2030, over 74 million people worldwide will have some form of dementia, with diet being a contributing factor.

Local

	Heart disease Cardiovascular Disease (CVD) will rise by 22% by 2030.
	Diabetes Type 2 diabetes will increase from 1.3 million Australians in 2020 to 2 million by 2030.
	Cancers Diet-related cancers will account for a substantial portion of the overall cancer burden by 2030.
	Dementia Dementia rates will double by 2050, reaching more than 812,500 by 2054.

Figure 1: Global and local snapshot of current and future trends linked to major diet related diseases[14–24]
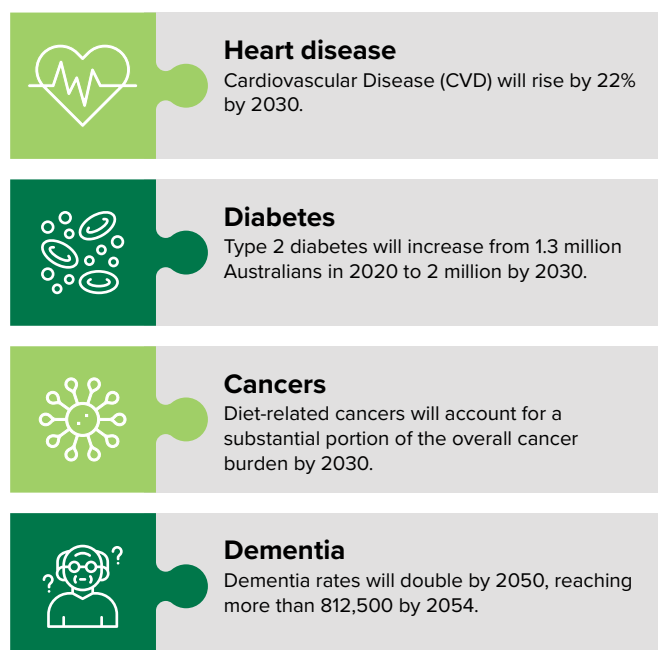
Research shows the leading dietary related risk factors for death and disability are a high intake of sodium, low intake of wholegrains and low intake of fruit[12].

A high intake of red meat (>23g/day of beef, pork, lamb or goat), while considered a risk factor, ranks towards the bottom in terms of impact[12]. Findings are not always consistent however with other reports suggesting a 30% reduction in red and processed meat intake could help reduce cases of type 2 diabetes, heart disease, colorectal cancer and deaths from all causes[23].

Malnutrition

Malnutrition, including undernutrition (wasting, stunting, underweight) or inadequate vitamins or minerals (hidden hunger) and overweight and obesity is a significant global health challenge[25].

Many countries experience a "triple burden of malnutrition" where all three of the above occur together in the same population, and even within the same family[26]. Key contributing factors are poverty, poor dietary choices and food supply chain.

Current status

Three hundred and nine million people face acute hunger in 71 countries – almost 200 million above pre-COVID-19 levels[27]. Of these, more than 37.2 million face emergency levels of hunger and 1.3 million are in the grips of catastrophic hunger[27].

In addition, over two billion people globally experience "hidden hunger."[28]

Across the world many children will experience the long-term effects of malnutrition such as stunting and underweight[29]. Of relevance, over half of preschool-aged children and two-thirds of non-pregnant women of reproductive age have at least one of three micronutrient deficiencies (iron, zinc, vitamin A)[30].

India accounts for a third of the global burden of under-nutrition[31].

In the Asia-Pacific, the prevalence of undernutrition is 8.8% while overnutrition among the same population is 23.0%[32]. The incoming Indonesian president recently announced a new school lunch program to assist in addressing hunger and malnutrition in the country's 83 million school children leading to significant opportunity for the Australian dairy industry to supply milk for the program[33].

In the Middle East and North Africa region one in three children have some form of malnutrition[34]. Fifty five million children in the region are overweight or obese, with these forms of malnutrition on the rise.

Locally in Australia, hunger and food insecurity are increasingly on the agenda. According to the latest Foodbank Hunger Report[35]:

- 3.7 million households (36%) ran out of food across the course of 2023 with 2.3 million experiencing severe food insecurity.
- 77% of households experiencing food insecurity did so for the first time in 2023.
- 383,000 more households struggled to put food on the table compared to the year before (2022).
- 48% of the general population feel anxious or struggle to consistently access adequate food.
- 94% of households affected coped by shifting how they spent on groceries. This included 48% who reduced spending on fresh produce and protein. 59% swapped usual foods for cheaper alternatives, including purchasing more tinned and frozen foods rather than fresh.

Nutrient poor diets

Lack of adequate food, along with excessive intakes of nutrient poor food, contribute to sub-optimal nutrient intakes. The last National Nutrition Survey found[36]:

- Just over one third of the kilojoules (35%) consumed by Australians came from foods low in nutritional value.
- Twenty two out of 31 nutrients were being consumed at levels less than recommended intakes[37].

Poor eating habits are leading to a re-emergence of diseases associated with poor nutrition. These include cases of night blindness[38] due to lack of vitamin A and vitamin D deficiency[39].

Lower than optimal intakes of lean red meat and alternatives influences nutrient intake, particularly affecting nutrients that are mainly sourced from this food group, likely contributing to the finding that 1.1 million Australians are estimated to be iron deficient[40].

Section summary

Observations

Prevalence of obesity and overweight is growing worldwide, along with diet related diseases.

Prevalence of malnutrition is improving but rates continue to remain high. Malnutrition now occurs in conjunction with obesity due to nutrient poor diets.

Iron deficiency is a common micronutrient deficiency locally and globally.

Emerging countries such as Indonesia are investing in providing school lunches for their children.

Red meat is nutrient dense and therefore has the potential to be part of the solution.

While red meat is classified as part of a healthy diet in government guidelines, high intakes are frequently implicated as a risk factor for dietary related diseases and their risk factors.

Implications

To continue to be recognised as part of the solution to overweight and obesity, it is critical red meat continue to be classified as an essential part of a healthy diet.

International investment in school lunch programs provides opportunities for the industry to be part of the solution to malnutrition.

Changing the tendency of researchers to classify red meat as a marker of a poor diet in research will assist the industry maintain and build its nutritional reputation.

Recommendations

Continue to monitor and respond to government policies locally and in relevant global markets to protect red meat's role as part of a healthy diet.

Undertake research to identify countries where governments are investing in food and nutrition based initiatives to address malnutrition, such as school lunch programs, and which provide opportunities to supply nutrient rich meat blends and/or nutrient rich meat based snacks e.g. Indonesia, China, India.

Formulate a strategy for improving the way red meat is defined in research and policy documents and assessments of diet related risk factors to help shift attention from red meat to high intakes of ultra-processed and discretionary foods as the real problem.

Nutritional attributes of red meat and offal

Below is an overview of the nutritional profile of beef, lamb, goat and offal. Given nutrient content is similar across cuts when trimmed of separable fat[41], a representative set of figures using mincemeat is provided as a snapshot. Nutrients where Australian data is available and which are present in amounts >10% of the Recommended Dietary Intake (RDI), Adequate Intake (AI) or Daily Intake (DI) are highlighted. A serving size of 150g is used (100g for offal) based on previous work by MLA indicating 3–4x a week x 150g serves is a useful way to communicate frequency and amount[41].

Table 2 Nutritional profile of regular beef mince

	Average quantity per 100g	Average quantity per serving (150g)	% Daily intake/RDI* (per serving)
Energy	710kJ (170Cal)	1065kJ	12% DI
Protein	22.4g	33.6g	67% DI
Fat, total	8.9g	13.4g	19% DI
– Saturated	3.8g	5.7g	24% DI
– Trans	0.3g	0.5g	
– Polyunsaturated	0.3g	0.5g	
– Omega-3s (total)	63mg	95mg	
– LC omega-3s	23mg	35mg	
– Monounsaturated	3.8g	5.7g	
Cholesterol	76mg	114mg	
Carbohydrate	0g	0g	0%
– Sugars	0g	0g	0%
Sodium	68mg	102mg	4% DI
Iron	1.5mg	2.3mg	19% RDI
Phosphorus	203mg	305mg	30% RDI
Potassium	348mg	522mg	n/a
Selenium	12ug	18ug	26% RDI
Zinc	2.3mg	3.5mg	29% RDI
Vitamin B3 (niacin)	7.3mg	11mg	>100% RDI
Vitamin B12 (cobalamin)	3ug	4.5ug	>100% RDI
Folate	21mcg	32mcg	16%RDI
Vitamin D	3.2ug	4.8ug	48% RDI
Choline^	61.2mg	92mg	22%AI (F); 17%AI (M)

Figures from Australian Food Composition database for raw regular beef mince[42]. ^Choline content from USDA database: Beef, ground, 85% lean meat / 15% fat, raw.
*RDI = Recommended Dietary Intake based on figures in Schedule 1 of the Australia New Zealand Food Standards Code. Daily Intake based on figures in Standard 1.2.8.

Table 3 Nutritional profile of regular lamb mince

	Average quantity per 100g	Average quantity per serving (150g)	% Daily intake/RDI* (per serving)
Energy	602kJ (170Cal)	903kJ	10% DI
Protein	20.4g	30.6g	61% DI
Fat, total	6.9g	10.4g	15% DI
– Saturated	2.4g	3.6g	15% DI
– Trans	0.3g	0.5g	
– Polyunsaturated	0.3g	0.5g	
– Omega-3s (total)	180mg	270mg	
– LC omega-3s	110mg	165mg	
– Monounsaturated	3.1g	4.7g	
Cholesterol	60mg	90mg	
Carbohydrate	0g	0g	0%
– Sugars	0g	0g	0%
Sodium	57mg	86mg	3% DI
Iron	1.8mg	2.7mg	23% RDI
Phosphorus	195mg	292mg	29% RDI
Potassium	270mg	405mg	n/a
Zinc	3.7mg	5.6mg	47% RDI
Vitamin B1 (thiamine)	0.09mg	0.14mg	13% RDI
Vitamin B2 (riboflavin)	0.19mg	0.29mg	17% RDI
Vitamin B3 (niacin)	14.2mg	21.3mg	>100% RDI
Vitamin B5 (pantothetic acid)	0.42mg	0.63mg	13%ESADDI˜
Vitamin B6 (pyridoxine)	0.56mg	0.84mg	53% RDI
Folate	17mcg	26mcg	13% RDI
Vitamin B12 (cobalamin)	1.7ug	2.6ug	>100% RDI
Vitamin D	3ug	4.5ug	45% RDI
Choline^	69.3mg	104mg	24%AI (F); 19%AI (M)

Figures from Australian Food Composition Database for raw lamb mince[43] ^Choline content from USDA database (Lamb, ground, raw). *RDI = Recommended Dietary Intake based on figures in Schedule 1 of the Australia New Zealand Food Standards Code. Daily Intake based on figures in Standard 1.2.8.

Table 4 Nutritional profile of regular goatmeat

	Average quantity per 100g	Average quantity per serving (150g)	% Daily intake/RDI* (per serving)
Energy	566kJ (135Cal)	849kJ	10% DI
Protein	21.2g	31.8g	64% DI
Fat, total	5.6g	8.4g	12% DI
– Saturated	2.9g	4.4g	18% DI
– Trans	0.4g	0.6g	
– Polyunsaturated	0.2g	0.3g	
– Omega-3s (total)	78mg	117mg	
– LC omega-3s	38mg	57mg	
– Monounsaturated	2g	3g	
Cholesterol	78mg	117mg	
Carbohydrate	0g	0g	0%
– Sugars	0g	0g	0%
Sodium	69mg	104mg	5% DI
Iodine	11mcg	16.5mcg	11% RDI
Iron	2.6mg	3.8mg	32% RDI
Phosphorus	175mg	263mg	26% RDI
Potassium	313mg	470mg	n/a
Selenium	11ug	17ug	24% RDI
Zinc	3.9mg	5.9mg	49% RDI
Vitamin B3 (niacin)	6.6mg	9.9mg	99% RDI
Folate	21mcg	32mcg	16%RDI
Vitamin B12 (cobalamin)	1ug	1.5ug	75% RDI
Vitamin D	2.8ug	4.2ug	42% RDI
Vitamin E	0.9mg	1.4mg	14% RDI
Choline^	106mg	159mg	37%AI (F); 29%AI (M)

Data from Australian Food Composition database entry for 'goat meat, untrimmed, raw'[44] ^Choline content from USDA database (Game meat, goat, cooked, roasted).
*RDI = Recommended Dietary Intake based on figures in Schedule 1 of the Australia New Zealand Food Standards Code. Daily Intake based on figures in Standard 1.2.8.

Table 5 Nutritional profile of beef offal per 100g^

Nutrient	Liver	% DI/RDI*	Sweetbread	% DI/RDI*	Tongue	% DI/RDI*	Tripe	% DI/RDI*
Kilojoules	494	6%	1333	15%	1069	12%	562	6%
Protein (g)	20.5	41%	11.3	23%	17.3	35%	14	28%
Long chain omega-3s (mg)	298	186–331%!	67	42–74%!	58	36–64%!	47	29–52%!
Vitamin A (ug)	28319	38x	20	3%	13	2%	9	1%
Thiamin (mg)	0.37	33%	0.09	8%	0.06	5%	0.05	5%
Riboflavin (mg)	2.35	138%	0.12	7%	0.2	12%	0.17	10%
Niacin (mg)	15.4	154%	1.95	19%	2.92	29%	7.19	72%
Vitamin B12 (ug)	84.5	42x	2	100%	5	250%	6.4	320%
Vitamin D (ug)^	0.88	9%	1.6	16%	1.95	19%	19%	2.5%
Vitamin E (mg)	1.8	18%	0.7	7%	1	10%	0.5	5%
Iron (mg)	8.4	70%	1.1	9%	1.8	15%	4	33%
Potassium (mg)	327		308		248		209	
Selenium (ug)	16.5	23%	8.6	12%	2.5	4%	3.1	4%
Zinc (mg)	3	25%	1	8%	2.6	22%	1.7	14%
Choline** (mg)	333	78% (F); 60% (M)	–		155	36% (F); 28% (M)	195	46% (F); 35% (M)

^Data from MLA (unavailable in the Australian Food Composition Database) ^Calculated from Vitamin D3 plus 25-OH Vitamin D3. *RDI = Recommended Dietary Intake based on figures in Schedule 1 of the Australia New Zealand Food Standards Code. DI = Daily Intake based on figures in Standard 1.2.8.

! Range based on NHMRC Nutrient Reference Values for adult men and women. **Choline data from USDA (Beef, variety meats and by-products, liver, raw; Beef, variety meats and by-products, tongue, cooked, simmered; Beef, variety meats and by-products, tripe, raw). AI is Adequate Intake and the reference amount for adults in the Nutrient Reference Values for Australia & NZ.

Nutritional highlights

Tables 2–6 indicate the following highlights for red meat and a selection of beef offal.

One serving of beef:

- provides 100% of the daily requirements for vitamins B3 (niacin) and B12
- provides more than two thirds of daily protein needs.
- is high in protein, phosphorus, selenium, zinc, niacin, vitamin B12 and vitamin D
- provides 8 essential vitamins and minerals, plus choline
- is a natural source of 12 essential nutrients (protein, omega-3s, iron, phosphorus, potassium, selenium, zinc, folate, niacin, vitamin B12, vitamin D and choline)
- provides a source of iron in a highly bioavailable form
- is naturally low in sodium.

One serving of lamb:

- provides 100% of the daily requirements for vitamins B3 (niacin) and B12
- provides more than half the daily requirements for vitamin B6
- provides more than 60% of daily protein requirements
- is high in protein, phosphorus, zinc, niacin, vitamin B12 and vitamin D
- provides a source of iron in a highly bioavailable form
- provides 8 essential vitamins and minerals, plus choline
- is a natural source of 15 essential nutrients (protein, omega-3s, iron, phosphorus, potassium, zinc, folate, vitamins B1, B2, B3, B5, B6, B12, vitamin D and choline)
- is a source of every essential B vitamin (except biotin (present in an amount of 7%RDI))
- is naturally low in sodium.

One serving of goat:

- provides 75% of the daily requirements for vitamin B12
- provides 64% of daily protein needs
- is high in protein, iron, phosphorus, zinc, niacin, vitamin B12 and vitamin D
- provides 11 essential vitamins and minerals, plus choline.
- is a natural source of 13 essential nutrients (protein, omega-3s, iron, iodine, phosphorus, potassium, selenium, zinc, folate, vitamins B3, B12, D, E and choline)
- provides a third of daily iron requirements in a highly bioavailable form
- is naturally low in sodium.

Highlights for 100g offal:

- Tripe provides a quarter of a persons recommended daily intake for vitamin D.
- Liver provides more than 100% of daily requirements for long chain omega-3s, vitamin A, niacin and vitamin B12.
- The long chain omega-3 content of all types of offal included provide between 29%–331% of daily recommendations.
- Liver provides 70% of the RDI for iron and 100% of the NHMRC daily recommendations for men, boys and girls aged 9–13 years, and women over 51 years. It provides 47% for women aged 19–50 years[45].
- All offal listed provide 100% or more of the RDI for vitamin B12.

Section summary

Observations

Red meat is nutrient rich providing 12–14 essential nutrients in a 150g serve.

Liver is very high in vitamins A, B3, B12, omega-3s and iron.

All offal is rich in vitamin B12.

There is a lack of comprehensive data about the nutritional profile of Australian offal.

Implications

Offal is nutrient rich yet under-consumed in the Australian diet (this will vary by country). The market for offal is expected to grow[46] potentially leading to greater interest in its nutritional profile.

There is good opportunity to expand and strengthen the nutritional messages associated with red meat.

Recommendations

Undertake a comprehensive nutritional analysis of offal, across type of animal and type of offal.

Consider utilising one representative set of nutritional figures per meat type for consistency in communication.

Combine small amounts of offal, particularly liver, in product innovation (see Section 3).

Key nutrients in red meat – deeper dive

Further detail about the specific health benefits of a selection of key nutrients in red meat and their role in consumer health and wellbeing, including the relevance of these nutrients to future health and wellbeing opportunities, is outlined in this section.

Protein

Of the 20 amino acids needed to build the proteins required for health and normal functioning of the body, nine are called 'essential' or 'indispensable' amino acids as they must be provided preformed in the diet. Red meat provides all nine of these (lysine, threonine, methionine, phenylalanine, tryptophan, leucine, isoleucine, valine) making it a source of high-quality protein. The amino acid glutamic acid/glutamine is present in meat in the highest amounts (16.5%), followed by arginine, alanine, and aspartic acid[47].

Many of these amino acids have additional health benefits beyond the formation of proteins in the body. For example, glutamine supplementation has been shown to have positive effects on the gut microbiota[48] and arginine may play a role in reducing high blood pressure through its effect on increasing nitric oxide levels in the blood[49].

The following table shows the amount of protein in 150g of beef, lamb and goat.

Table 6 Protein content of beef, lamb and goat

Meat type	Protein (grams per 150g)	%RDI
Beef	33.6	61%
Lamb	31.8	67%
Goat	30.6	64%

*Daily Intake, as defined by FSANZ. The DI for protein is 50g.

Consumer interest in high protein products continues to be strong. Sales of protein/energy bars grew 9.4% in 2023, reaching a market value of over AUD300 million with their appeal stretching across sports, older adults and those looking to manage weight[50].

The future for protein

In their 2022 report 'Protein: A roadmap for unlocking technology-led growth opportunities for Australia' the CSIRO identified a $13 billion market opportunity for Australia to grow and diversify its high-quality protein products from various sources[51].

One of the strategies included in the report was turning lesser cuts of red meat into value-added protein powders and nutraceuticals (discussed in Section 3 of this report). They estimate the value for this to grow from $1 billion currently to a conservative estimate of $1.4 billion by 2030 and an ambitious value of $5.1 billion.

Iron

Iron is required daily in the diet to carry oxygen around the bloodstream, for immunity, growth and development in children, energy production and optimal mental functioning.

Amount in red meat

The following table shows the amount of iron in red meat and compares this to pork, chicken and fish.

Table 7 Iron content of a variety of protein rich foods.

Meat type	Iron content (mg/150g)	%RDI*
Liver	12.6	>100%
Tripe	6	50%
Goat	3.8	32%
Lamb	2.7	23%
Beef	2.3	19%
Pork	1.4	12%
Chicken	0.6	5%
Pink fish – salmon	0.5	4%
White fish – whiting	0.3	3.6%

*Recommended Dietary Intake, as defined by FSANZ. The RDI for iron is 12mg.

Advantages of iron from meat

Iron exists in two forms – heme and non-heme. Heme iron is much more readily absorbed by the body (15-35% absorption rate compared to less than 10% for non-heme iron) and is only found in animal foods[52]. Thirty to 70% of the iron in red meat is in the form of heme iron, meaning it is a valuable source of this nutrient.

In developed countries, iron requirements are mainly met by red meat[52]. In contrast, in underdeveloped and developing countries, iron intake often depends on plant-based diets that contain mostly non-heme iron[53]. This is one contributing factor to the higher prevalence of anaemia in these countries.

The future of iron

Iron deficiency is one of the world's most common nutritional deficiencies affecting 30% of the global population[54]. Around 20% of women aged 15–49 years and children aged 6–59 months in European, Western Pacific and regions of the Americas have anaemia[54]. In some regions of Africa and South Asia, anaemia can affect up to 63% of children and 48% of women and it is also a relevant issue locally.

It is estimated that around half of anaemia cases are caused by iron deficiency. WHO recommends anaemia is ideally addressed through dietary diversification and improved access to foods that have high levels of bioavailable iron, including animal products[54].

Point of sale communication opportunities

Approved general level health claims that can be used on packs and in advertising red meat that link iron to health benefits in Australia/New Zealand include the following:

- essential for energy production
- reduces tiredness and fatigue
- necessary for immunity
- necessary for healthy brain development in babies
- needed for cognitive function
- needed for growth and development in children.

Zinc

Zinc is required by the body for the maintenance of a strong immune system, healthy eyes and skin and for growth and sexual development. It is involved in the activity of over 200 enzymes in the body.

Sources

Zinc is found in a variety of foods, particularly animal products (meat, shellfish, dairy), but also in plant foods like legumes and seeds. Diets based primarily on cereals and legumes however (which are high in phytates, substances that inhibit zinc absorption) often lead to inadequate zinc intake.

Amount in red meat

The following table shows the amount of zinc in red meat and compares this to pork, chicken and fish.

Table 8 Zinc content of a variety of protein rich foods

Meat type	Zinc content (mg/150g)	%RDI*
Goat	5.9	49%
Lamb	5.6	47%
Liver	4.5	38%
Tongue	3.9	33%
Beef	3.4	28%
Pork	3.3	28%
White fish – whiting	1.2	10%
Chicken	1.0	8%
Pink fish – salmon	0.6	5%

*Recommended Dietary Intake, as defined by FSANZ. The RDI for zinc is 12mg.

Advantages of zinc from red meat

Zinc bioavailability from beef is about fourfold greater than it is from a high-fibre breakfast cereal[55] and when meat is given as a complementary food to breast-fed infants there is a 16-fold greater amount of zinc absorbed compared to a fortified infant rice cereal[56].

The future of zinc

Around 17% to 30% of the global population is at risk of zinc deficiency, particularly in low- and middle-income countries[57].

The most vulnerable groups are children, pregnant women, and breastfeeding mothers. Around 30% of children under five years in developing countries suffer from zinc deficiency and it is responsible for about 4% of child deaths globally, largely due to its link with increased rates of infection[58].

Red meat, along with red meat products, including high zinc parts of the carcass such as liver and tongue, may be of value to help address global and local zinc deficiencies.

Point of sale communication opportunities

Approved general level health claims that can be used on packs and in advertising red meat that link zinc to health benefits in Australia/New Zealand include the following:

- necessary for immunity
- needed for healthy skin, hair and nails
- necessary for wound healing
- necessary for normal growth and development in children
- needed for cognitive function
- necessary for fertility and reproduction
- needed for healthy vision
- protects cells from free radicals
- necessary for healthy bones.

Vitamin B12

Vitamin B12 is required in the body to form and regenerate red blood cells, produce DNA (genetic material), maintain a healthy nervous system and metabolise carbohydrate, protein and fat.

Vitamin B12 deficiency can result in a type of anaemia called megaloblastic anaemia, neurological and cognitive issues and developmental delays along with failure to thrive in infants.

The recommended dietary intake (RDI) for vitamin B12 in the Food Standards Code is 2micrograms. The RDI for different ages and genders as outlined in the NHMRC Nutrient Reference Values[45] ranges from 0.9mcg for young children 1–3 years up to 2.8mcg for lactating women. The adult and adolescent RDI is 2.4mcg.

Sources

Vitamin B12 is only found in animal foods such as meat, poultry, seafood, shellfish, eggs, cheese, yoghurt and milk. Some foods, particularly those targeting vegetarians, may be fortified with vitamin B12, for example, some soy beverages.

Amount in red meat

The following table shows the amount of zinc in red meat and compares this to pork, chicken and fish.

Table 9 Vitamin B12 content of a variety of protein rich foods.

Meat type	Vitamin B12 content (ug/150g)	%RDI*
Liver	84.5	42x
Tripe	7.5	3.7x
Beef	4.5	>200%
Pink fish – salmon	3.3	>100%
Lamb	2.6	>100%
White fish – whiting	2.2	>100%
Goat	1.5	75%
Pork	0.8	40%
Chicken	0.4	20%

*Recommended Dietary Intake, as defined by FSANZ. The RDI for vitamin B12 is 2mcg

Advantages of vitamin B12 from red meat

The amount of vitamin B12 present in red meat is very high making it a convenient source of this nutrient. Consuming red meat regularly makes it easy for individuals to meet their daily intake.

The future of vitamin B12

Vitamin B12 deficiency is prevalent worldwide, with varying rates depending on the region, age group, and dietary habits[59]. Those at higher risk are:

- people living in regions such as South Asia, Sub-Saharan Africa, and parts of Latin America where access to animal products may be limited due to economic or cultural factors
- older adults due to decreased absorption through the gut
- vegetarians and vegans due to lack of animal-based foods
- people with certain medical conditions that can impair vitamin B12 absorption
- people on medications such as metformin (used for diabetes) and proton pump inhibitors (used for acid reflux) can also experience a reduction in B12 absorption.

WHO and FAO have stressed the importance of addressing micronutrient deficiencies, including vitamin B12, through integrated public health initiatives.

There is a strong association between consumption of animal foods and serum vitamin 12 concentrations[59] meaning if animal-based foods are eliminated from the diet, vitamin B12 deficiency will likely rise as a global and local health issue.

A potential role of vitamin B12 for mild cognitive impairment, depression, pregnancy and pregnancy outcomes, and its role in lowering homocysteine levels, a risk factor for cardiovascular disease, are currently being explored.

Point of sale communication opportunities

Approved general level health claims that can be used on packs and in advertising red meat that link vitamin B12 to health benefits in Australia/New Zealand include the following:

- needed for a healthy nervous system
- needed for normal psychological function
- necessary for a healthy immune system
- helps reduce tiredness and fatigue
- needed for energy metabolism
- necessary for growth and development in children.

Omega-3s

Omega-3 fatty acids are a group of polyunsaturated fats that play an important role in the structure of cell membranes in the body. There are several different types of omega-3 fatty acids including alpha-linolenic acid (ALA) and the long chain omega-3s eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). These are considered essential fatty acids as the only practical way to increase levels in the body is through dietary intake.

An increased intake of long chain omega-3 fats protects against heart disease, some inflammatory diseases and certain autoimmune disorders[60]. Omega-3 fats also play an important role in infant growth and development[61]. They are also important during aging to reduce cognitive decline and play a role in mental health[62].

Recommended intakes

The Australia New Zealand Food Standards Code uses a reference amount of 60mg total eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) per serving for a food to claim it is a good source of omega-3s.
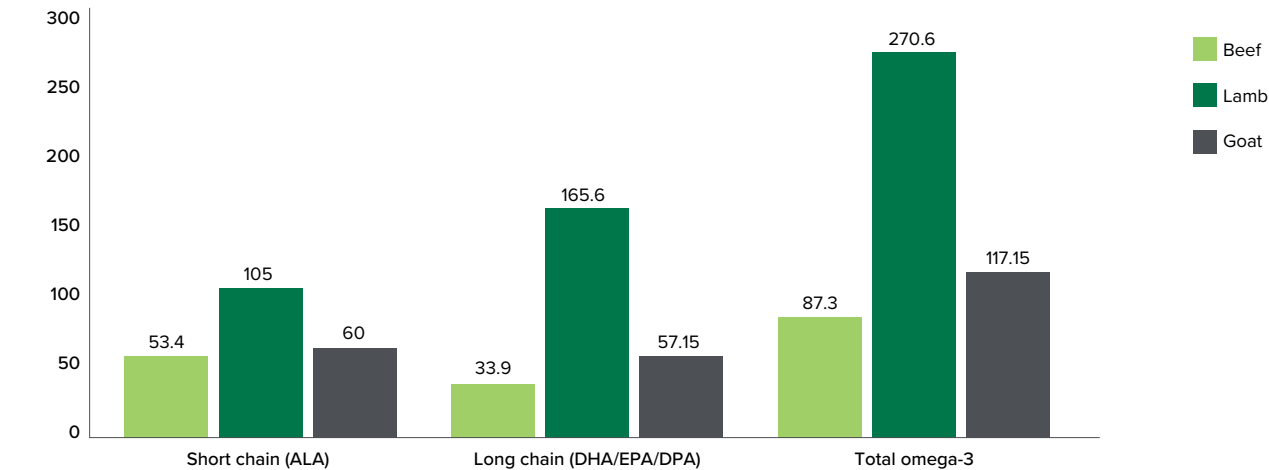
The National Health & Medical Research Council (NHMRC) Nutrient Reference Values include Adequate Intake (AI) recommendations for omega-3s[45]. There is also a Suggested Dietary Target (SDT) value for adults due to evidence for the benefits of long chain omega-3 for chronic disease prevention at levels higher than the AI. These values are indicated in the table below.

Table 10 Daily intake recommendations for omega-3s

	ALA	DHA/EPA/DPA – general	DHA/EPA/DPA – suggested dietary target	Total omega-3
Men	1.3g	160mg	610mg	1.46g
Women	0.8g	90mg	430mg	0.89g
Pregnant women	1.0g	115mg	N/A	1.115g
Lactation	1.2g	145mg	N/A	1.345g

Australians' intakes of omega-3 fatty acids

Only 20% of Australians meet recommended omega-3 intakes and only 10% of women of childbearing age meet the recommended docosahexaenoic acid (DHA) intake[63]. When it comes to chronic disease prevention men consume about half of the SDT and women consume about 60%.

Sources of omega-3s

Meat contributes 21.4% of the long chain omega-3s in the Australian diet while seafood is the main contributor accounting for 55.7%[36]. Other sources of omega-3s in the diet include eggs, canola oil, soybeans, flaxseeds, walnuts and chia seeds.

Amount in red meat

The omega-3 content of 150g of red meat is indicated in Figure 2.

As indicated, lamb provides a high amount of long chain omega-3's making this a particularly valuable source of this nutrient. A 150g serve of lamb mince provides more than 100% of the AI for men and women, including pregnancy and lactation.

The future for omega-3s

There is growing global concern over inadequate intake of omega-3 fatty acids, particularly EPA and DHA, due to declining fish consumption and diets high in processed foods. Omega-3 deficiency is linked to significant health problems, including heart disease, high blood pressure, cognitive decline,

Figure 2 Omega-3 content of red meat (mg per 150g)

and developmental issues in children. Efforts to address this deficiency include encouraging fish consumption, fortifying foods with omega-3s, and promoting omega-3 supplements[64].

Red meat, particularly lamb, can play a useful role in boosting intakes, particularly for those who don't eat fish.

Point of sale communication opportunities

A general level health claim linking omega-3s with heart health is allowed for foods that contain >/= 50mg DHA + EPA/100g and <5g saturated fat/100g or <5g saturated fat/100g. Based on the figures for lamb in this report, it is only 1mg of omega-3s off qualifying for this health claim. Other cuts of lamb may qualify and this is worth exploring through further analysis.

Choline

Choline is a type of phospholipid required by the body for cholesterol and fat metabolism, and transport of fat from the liver. It is essential for production of the neurotransmitter acetylcholine, which is involved in nerve and brain functioning and memory and as a component of myelin, the insulating sheath around nerves. It is needed by every cell in the body as it is necessary for healthy cell membranes.

Choline is important during pregnancy and infant development as it supports normal brain development[65]. Higher choline intakes have been associated with lower type 2 diabetes risk[66], lower risk of high blood pressure[67], gains in muscle mass and strength in older adults[68], lower cardiovascular disease risk, especially stroke[69], positive effects on cognitive function in older people and a reduced risk of dementia and Alzheimer's disease[70].

While the body makes some choline, it is insufficient for the maintenance of good health. Research demonstrates that a diet devoid of choline causes liver and muscle dysfunction within three weeks[71].

Recommended intakes

The Adequate Intake (AI) values for choline in Australia are as follows[45]:

Children 1–3 years	200mg
Children 4–8 years	250mg
Children 9–13 years	375mg
Boys 14–18 years	550mg
Girls 14–18 years	400mg
Men	550mg
Women	425mg
Pregnant women	440mg
Lactation	550mg

Australians intake of choline

Less than 10% of the population by age and gender achieve the Adequate Intake recommendations for choline with an average intake of 265mg a day[72]. Red meat, eggs, nuts, legumes, and dairy together account for 50% of choline intake[72]. US research shows beef accounts for 11% of dietary choline in the American population[73].

Amount in red meat

The choline content of red meat and offal is highlighted in Figure 3. Liver is the highest source of choline followed by tripe and goat.

The future for choline

Choline is receiving increasing attention in the research literature. The role it plays in infant and maternal health and wellbeing and in the diets of older people for disease risk reduction and improved cognition are exciting areas of research for the red meat industry to monitor now and into the future.

Point of sale communication opportunities

General level health claims can be made about the presence of choline for foods providing at least 50mg per serve (all types of red meat included in this report). Examples are:

- need for normal fat metabolism
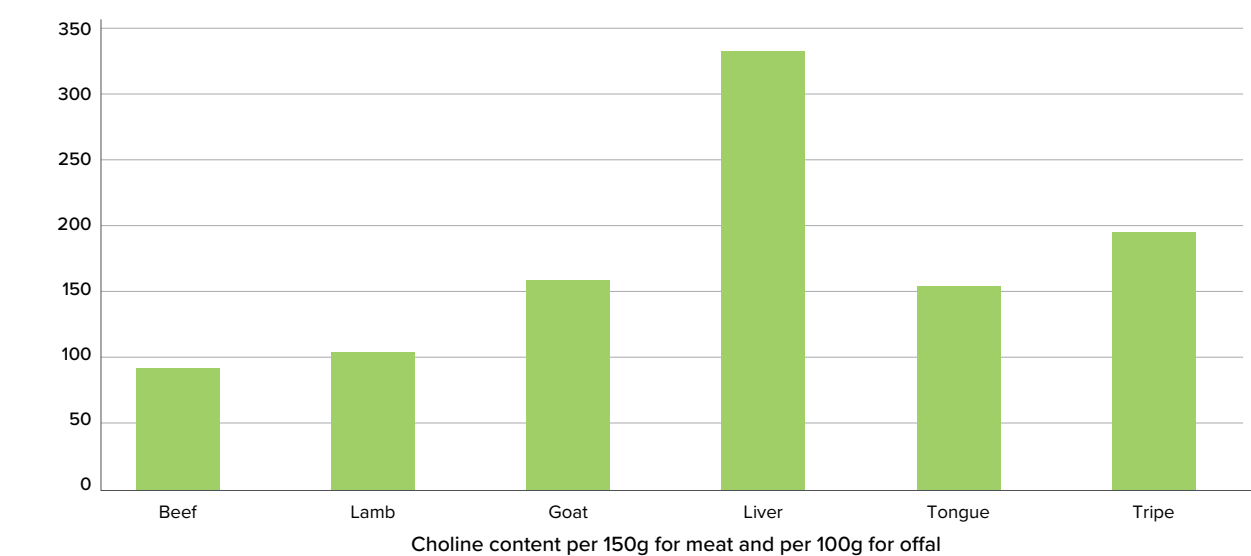- helps maintain healthy liver function.

Figure 3 Choline content of red meat and offal

Section summary

Observations

Consumer demand for protein remains strong and red meat, as a source of high-quality protein, is well placed to do more in this space.

A significant number of health-related claims can be used on red meat product packaging and in advertising linked to its nutrient content. Market assessment indicates this is rarely done at retail – the primary place consumers obtain their product information.

Choline represents an opportunity for new communication messages.

Implications

Opportunity exits to expand on pack communications linking the nutrient content of red meat to health benefits.

The high nutritional value of liver lends itself to being blended with other red meats to develop high nutritional value offerings.

Innovation is possible at low cost through the application of existing health claims linked to nutrient content in consumer marketing.

Recommendations

Develop products for specific consumer segments and match health claims to specific health and wellness areas of interest. For example, zinc and immunity, vitamin B12 and energy, protein and muscle gain.

Continue to pursue innovation with mince and offal blends to create nutrient-rich differentiated offerings linked to health benefits.

Further assess consumer acceptance of a heart health claim linked to lamb and its omega-3 content (TBC with further exploration).

Consider communication of nutrient bundles that emphasise the value of red meat during pregnancy e.g. the presence of choline, folate, vitamin D, protein, B vitamins, iron and zinc.

Current intake of red meat

Trends in consumption of red meat locally and globally are outlined in this section, indicating where barriers and opportunities exist.

Australian consumption

Analysis of the last National Nutrition Survey indicates average red meat intake (defined as beef, lamb, goat, pork, kangaroo and other game meat such as venison and rabbit) is 57g per day with approximately half of the population eating red meat on any given day[74]. Adults consume on average 61.6g and children 42g per day. These figures exclude processed meat which accounts for an additional approximate 27g per day for both adults and children (sausage, ham, bacon, salami, luncheon meats). Beef is the major source of red meat representing 69% and 75% of total red meat intake for adults and children respectively.

Males eat more red meat than females (68.5g vs 46.9g respectively). Males also consume more processed meat than women (33.2g vs 20.6g respectively).

Adult men eat 50% more red meat than adult women (75.2g vs 50.1g per day respectively).

Trends in consumption over time

In the years between the last two national nutrition surveys (1995 to 2011/12) red meat was consumed by fewer people (declining from 56% to 49%), however the amount consumed was reportedly higher meaning per capita intakes remained similar[75].

In the ten-year period from 2011 to 2021, approximately two-thirds of Australian consumers maintained their level of red meat intake, 28% reduced their consumption and 9% increased it[76].

In 2024, fewer people reported reducing their consumption of red meat (24% compared to 28% in 2021) while the remaining 76% said they will keep consuming red meat. Reasons for reducing intake are cost, environment, health and animal welfare. Reasons for maintaining intake are nutritional value, health reasons and taste[76].

Apparent Consumption data from the Australian Bureau of Statistics identified a shift toward unprocessed meat with more than three-quarters (79%) of all meat consumed being unprocessed in 2022–23, slightly higher than in 2018–19 (77%)[77].

Are Australians eating enough red meat?

Based on an average intake of 61.6g a day of red meat for adults, and 42g a day for children, the average weekly intake of red meat is 431g for adults and 294g for children. Assessment by gender indicates adult men eat 526g a week and women around 350g.

The Australian Dietary Guidelines recommend consuming up to 455g cooked lean red meat per week and state some population groups such as children and young women may need to increase their intake of lean red meat, while most Australian men eat more red meat than is recommended and would benefit from reducing their intake[45].

Despite this, when looking at the total meat and alternatives food group in a broader sense, daily servings from this group (as defined in the Australian Guide to Healthy Eating), are below recommendations (see Figure 4).

Insufficient intakes of all core food groups are a major risk factor for nutrient deficiencies and chronic disease including malnutrition, obesity and overweight.
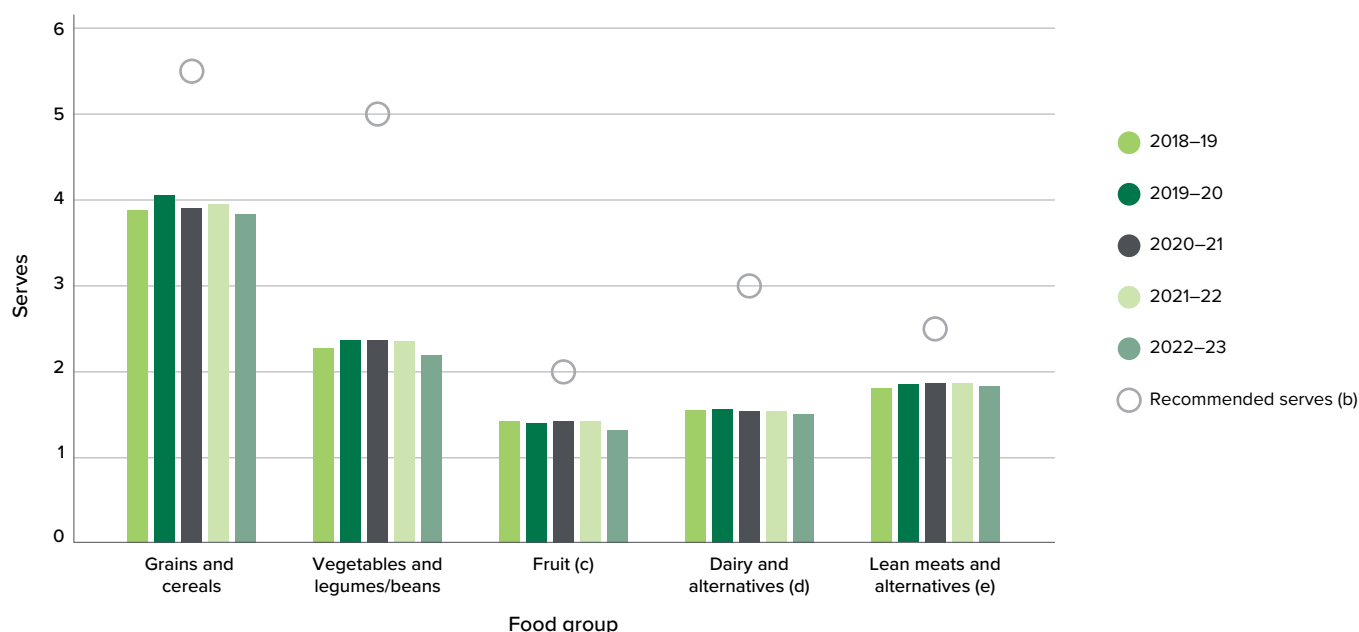

Figure 4 Apparent consumption of daily serves of five food groups compared with recommended minimum serves, 2018–19 to 2022–23. Source: ABS[77]

Future demand/trends in consumption

While Australian per capita consumption of red meat has declined slightly over the past 5–7 years, ABS forecasts are that Australia's population will reach around 30 million people by 2032, up from 26 million in June 2022[78].

Future demand for red meat is therefore likely to rise overall, due predominantly to population growth.

Innovation in areas such as value-added protein products and nutraceuticals, will provide additional growth opportunities. This is covered more in Section 2.

Global consumption

Current intakes

Estimates put average global per capita consumption of beef at 6.3kg and sheep meat at 1.8kg[79], equating to 22g per day. One scientific study assessing dietary risk factors put red meat consumption (beef, pork, lamb and goat) at 27g per person per day[12]. These estimates indicate lower global than local consumption of red meat.

Meat consumption is highly correlated to income as indicated in Figure 5.

Over the past 20 years, total global consumption of meat has been steadily increasing at an average annual rate of 1.0% for beef, 1.9% for sheep meat, 1.4% for pork, and 3.1% for poultry meat[81].

Future trends

Future consumption patterns will differ between high, medium and low-income countries and will also be influenced by culture and religion.

In high income countries, concerns about human health, environmental impacts and animal welfare are prompting consumers to switch preferences among meat products (e.g. red vs white meat) or to reduce overall meat demand[82].

In middle-income countries like Vietnam and Indonesia, economic growth, urbanization, and the penetration of the fast-food industry, are predicted to drive growth, resulting in increased demand for red meat as incomes rise and diets shift. Asia overall is projected to account for over 50% of the total increase in meat demand globally[82].

In low-income countries, high population growth is expected to continue to drive higher meat consumption, with per capita consumption constrained by relatively low income levels.

By 2050, global meat production and demand is expected to increase by 52% in a business as usual scenario and just under 30% in a 'towards sustainability scenario'[83] (compared to 2012 levels).

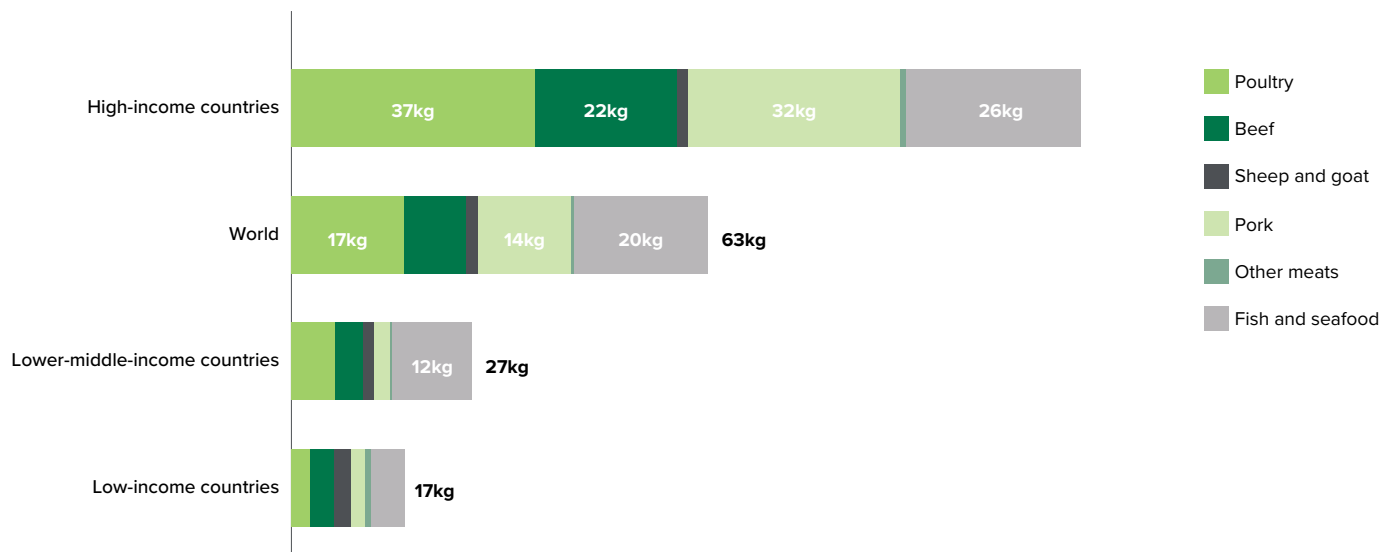For more statistics on local and global meat consumption, see MLA's Economic Outlook Report for 2023[81] .

Figure 5 Per capita meat consumption by type and income levels[80].

Section summary

Observations

Red meat consumption is driven by a multitude of factors with concerns about human health being one factor contributing to dampening demand in higher income countries.

Increasing affluence in low-middle income countries will drive growth in demand with Asia representing a significant potential growth opportunity.

Locally, adult men tend to eat more than the recommended intake of red meat according to the Australian Dietary Guidelines, while women and children under-consume.

Implications

Addressing the human health concerns of red meat consumption is needed to reduce barriers to consumption in high income countries.

Marketing messages encouraging increased consumption are relevant for emerging markets and for specific sub-groups within the population locally. The next section will expand on this.

Recommendations

Direct messages about the health benefits of increased consumption of red meat to low-middle income countries for improved nutrition, while targeting specific benefits for women and children locally.

Additional future growth opportunities for red meat in high income countries may be found through development of value-added functional foods.

More on this can be found in Section 2.

The role of red meat across the life stages

This section covers the role of red meat in key life stages including:

- The first 1,000 days of life
- Toddlers (12 months–2 years)
- Children and adolescents (6–17 years)
- Women of child-bearing age (16–44 years)
- Older adults (65+ years)

The first 1,000 days

The first 1,000 days of a child's life covers conception to two years and critically shapes development and wellbeing both in the short and long term. Poor nutrition at this time can cause epigenetic changes that have life-long implications for chronic disease risk[84]. As a result, public health efforts now include protecting adults from chronic disease by focusing on good nutrition in the first 1,000 days of life[85].

Pregnancy and lactation

Essential nutrients that are highly bioavailable in red meat are needed in greater amounts in pregnancy and during lactation to support foetal development. These include protein, zinc, iron, choline, folate, iodine, vitamins A, D, B6 and B12 as well as long-chain omega-3 fats[65] . Iron requirements are very high, increasing from 18mg to 27mg/day in pregnancy before dropping to 9mg after birth. Iron deficiency during this time may have consequences for the babies brain development, immune function and cognition[86].

Details on the nutritional requirements for mothers are covered in the 'Women of child-bearing age' section below.

Introducing solids

The National Health & Medical Research Council's (NHMRC) Infant Feeding Guidelines recommend introducing solid foods at or around the age of six months when appetite and nutritional requirements are no longer satisfied by breast milk or infant formula alone[87]. Given the lack of iron in human breast milk, iron-rich nutritious foods, including pureed meat, are specifically recommended to help prevent iron deficiency. The World Health Organisation's Guidelines also recommend animal sourced foods be consumed daily in the context of a diverse and healthy diet at this time[88].

> **Red meat is an important iron-containing food recommended as one of an infant's first foods around six months of age.**

Iron

Human breast milk contains very little iron[89] meaning infants experience a decline in blood volume and haemoglobin concentration after birth[90]. By six months they are dependent on solid foods to meet iron requirements to support brain development and prevent iron deficiency.

In North America (and Australia), early iron rich foods given to infants are most commonly iron-fortified cereals[91] which contain non-heme iron, absorbed at a rate of < 5%[92]. Much of this iron therefore remains in the gut where it has been shown to contribute to the generation of reactive oxygen species (ROS)[91]. Infants receiving iron-fortified cereals are consuming similar levels of iron that may subject them to inflammation[93].

One review suggested meat as the best source of iron to introduce during the weaning phase as it contains no residual iron[91]. It also provides more readily absorbed heme iron[94] however, it is among the least common complementary foods introduced to infants[91].

It is therefore not surprising that in one study 24% of Canadian infants were shown to have low iron stores[95] and although there are no similar Australian prevalence figures, one study found approximately 90% of infants aged 6–11.9 months and 25% of toddlers aged 1–2 years had inadequate iron intake[96].

To date, no studies have considered the safety of iron fortified cereal (traditional) and meat in relation to ROS generation and inflammation, and few have assessed the effect of iron fortification on the gut microbiome of breastfed infants. This warrants further study as the infant gut microbiota plays a role in risk of allergic disease, obesity and other inflammatory and gastrointestinal disorders.

Zinc

By late lactation, the zinc content of human milk is insufficient to meet requirements meaning solid foods in the weaning period must be high in zinc and have good bioavailability. Studies suggest the introduction of meat as an early complementary food for exclusively breastfed infants is associated with improved zinc intake and potential benefits[97].

> **Red meat provides iron, zinc, choline and vitamin B12 – four key nutrients for brain development and cognition.**

Nutrient contribution from lean red meat to infants 6–12 months

Overall, red meat consumption in infancy is associated with healthy growth and development in infants. Using an amount of 2 tablespoons a day (40g) as a potentially appropriate amount for infants 6–12 months, table 11 demonstrates the contribution red meat makes to nutrient intakes.

Table 11 Nutrient contribution of 40g red meat to the diets of infants 7–12 months

Nutrient	Function	Adequate intake 7–12 months	Amount in 40g red meat*	% AI contribution from lean red meat* (40g)
Protein	Growth and development	14g	9g	64%
Iron	Development of haemoglobin (Hb) and prevention of anaemia	11mg	0.6mg	5%
Zinc	Cell growth, immunity, gene expression	3mg	0.9mg	30%
Vitamin B12	Healthy brain and blood cell development; support normal functioning of the nervous system	0.5mcg	1.2mcg	240%
Vitamin D	Strong bones and teeth; reduction in risk of CVD later in life	5mcg	1.3mcg	26%
Vitamin B3 (niacin)	Healthy nervous system and helps support cognition	4mg	2.9mg	72%
Choline	Healthy brain development. Reduction in risk of neurodevelopmental disorders	150mg	24.5mg	16%
Total omega-3	Healthy brain and eye development	0.5g	25mg	5%

*Figures used are for beef mince

Toddlers (12 months–2 years)

By this age, toddlers are eating a variety of family foods with small, frequent and nutrient-dense meals from the five food groups being recommended.

Figure 6 shows the nutrient contribution of red meat to Recommended Dietary Intakes for a variety of nutrients in the diets of toddlers 12–24 months.

Benefits of including lean red meat regularly in the first 1,000 days

Higher intake of beef, zinc, and choline at 6–12 months has been associated with better attention and inhibitory control at 3–5 years of age[98] and children who eat meat in the 12–36 month age bracket have a lower odds of iron deficiency[99] which is associated with better school achievement, job potential and lower risk of psychopathology making red meat a valuable early food for infants and toddlers.

Young children (3–5 years old)

Early food experiences shape later preferences making this stage critical for influencing lifelong healthy eating habits. However research shows that this time can be a period of fussy eating with poor dietary and lifestyle habits, including a high intake of discretionary foods[100] and low physical activity.

Nutrients of particular importance at this time of life include protein, iron, zinc, vitamin A and iodine, calcium and vitamin D. One study in children aged 12–36 months recommended eating meat according to recommendations as a useful target for the prevention of iron deficiency at this time[101].

It is common for children at this age to attend childcare and government menu planning guidelines for these venues commonly encourage the incorporation of lean red meat at least 6 times in a fortnightly menu. The contribution frequent red meat intake can make to iron intake in this age group is emphasised[102].
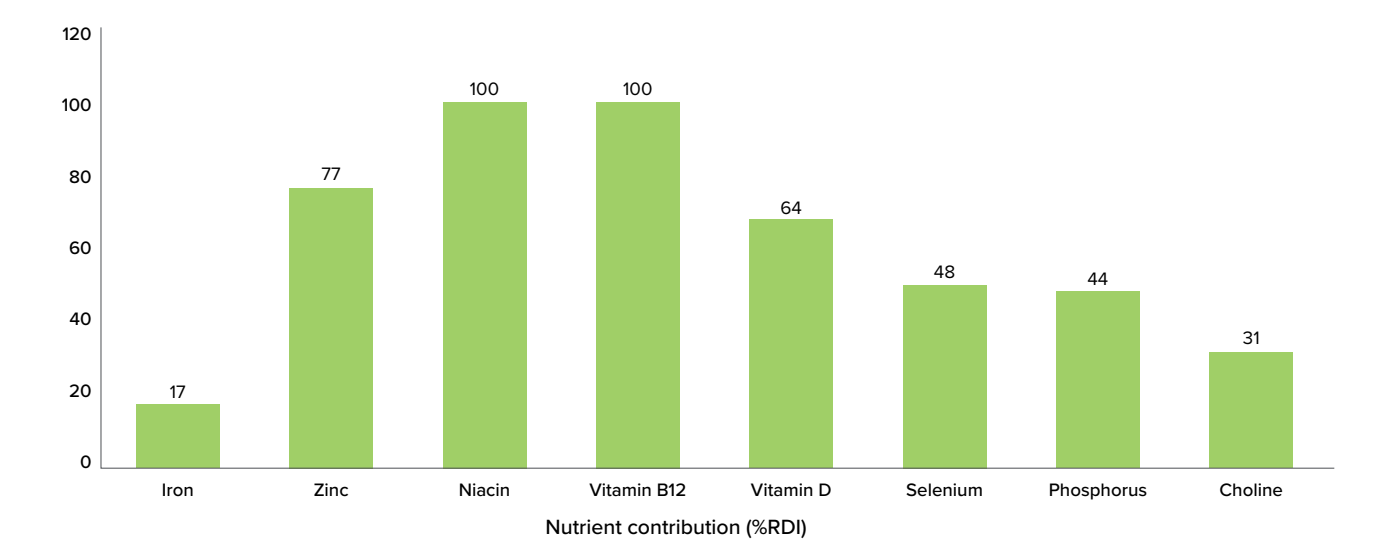

Figure 6 Contribution of red meat to daily nutrient intakes for infants 12 months–2 years (based on 100g beef mince)
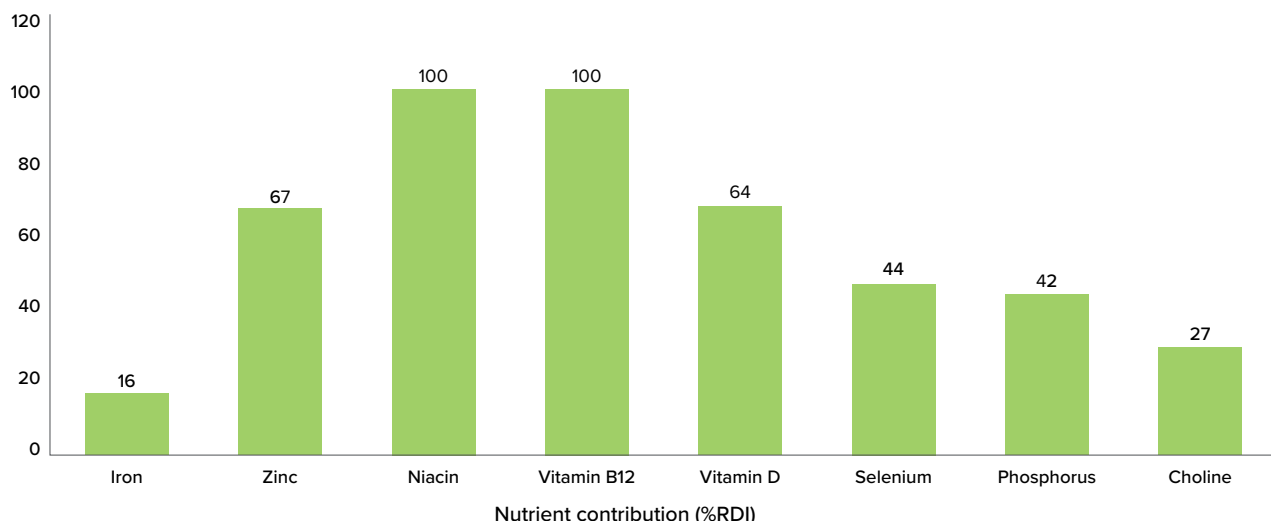
Figure 7 Average contribution of lean red meat to daily nutrient intakes for children 3-5 years (based on 100g beef mince)

Nutrient contribution from lean red meat to children 3–5 years

Figure 7 shows the contribution lean red meat makes to the Recommended Dietary Intake for a selection of nutrients in the diets of children 3–5 years of age.

Role of red meat for children aged 3–5 years

Figure 10 at the end of this section highlights the contribution red meat can make to various areas of health and wellbeing at this life stage.

Children and adolescents (6–17 years old)

While this life stage is a time of rapid growth and development, many children and teens in this age group are consuming poor quality diets with high intakes of discretionary foods36.

Overweight and obesity remain a concern, along with mental health. Almost two in five young Australians now live with a mental illness – a 50% increase over the last 14 years[103]. Suicide is the leading cause of death for 15–24 year olds[104] and around a third (31.6%) of Australian adolescents engage in disordered eating behaviours within any given year[105].

Foundation for the future

Healthy eating at this stage of life provides a foundation for future health and is necessary to support rapid growth and development, maintain a healthy weight and support mental health and wellbeing[106]. It is also associated with reduced low-grade inflammation, reducing the long term risk of chronic disease and mental health disorder[107].

While healthy eating is critical at this life stage, research shows inadequate intakes of a range of nutrients in these age groups. Those found in lean red meat and/or offal are listed in Table 10 at the end of this section.

> **Lean red meat provides key nutrients including iron, zinc, B-vitamins, choline and the antioxidant selenium all of which play important roles for mental and physical health and development for children and teenagers.**
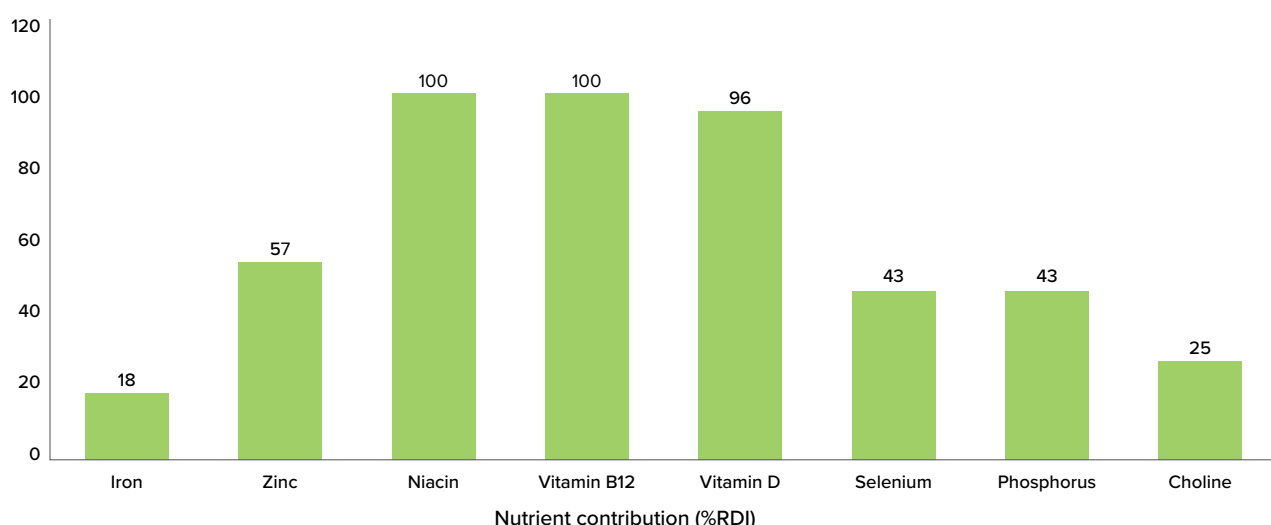

Figure 8 Average contribution of lean red meat to daily nutrient intakes for children and adolescents 6–17 years (based on 150g beef mince)

The role of lean red meat for children aged 6–17 years

Red meat provides critical nutrients in a bioavailable form, including iron, zinc, DHA, choline and vitamin B12 to help meet the needs of brain development in middle childhood and adolescents.

It also provides nutrients that contribute to areas of health and wellbeing in the diets of older children and teenagers as indicated in Figure 10 at the end of this section.

Figure 8 shows the contribution lean red meat makes to Recommended Dietary Intakes of key nutrients for children and adolescents aged 6–17 years.

Average intake of lean meat and alternatives

The National Nutrition Survey shows the recommended amounts of lean meat and alternatives is not being met by the majority of children and adolescents.

Table 12 Intake of lean meat and alternatives in children and adolescents compared to recommended intakes.

Age and gender	Recommended number of serves daily	Median intake*	Proportion not meeting recommendations*
4-8 years			
Males	1 ½	0.8	99.6%
Females	1 ½	0.7	99.9%
9–11 years			
Males	2 ½	1.2	96.5%
Females	2 ½	1.0	99.8%
12–13 years			
Males	2 ½	1.3	95.8%
Females	2 ½	1.2	99.3%
14–18 years			
Males	2 ½	1.7	85.1%
Females	2 ½	1.3	98.6%

*Figures used are for beef mince

Women of child-bearing age (16–44 years)

Women of childbearing age who are planning a pregnancy, or at risk of becoming pregnant, are encouraged to maintain adequate nutritional status to ensure the needs of the foetus are met at the early stages of pregnancy. Folate, iodine, choline and vitamin B12 are particularly vital for early foetal growth and development. Iron, vitamin D and omega-3s are also critical during pregnancy due to their strong association with infant and maternal health outcomes.

Nutrient requirements

Energy and nutrient requirements increase in pregnancy and adding a small portion of lean red meat, such as 65g cooked (1 serve according to the Australian Guide to Healthy Eating) is a valuable way to help meet these increased requirements. Table 13 below shows the difference this can make.

Table 13 Contribution of lean red meat to the additional nutrient requirements during pregnancy[45].

Nutrient	Additional requirements during pregnancy	% additional RDI provided by 65g lean beef mince
Protein	14g	>100%
Iron	9mg	16%
Zinc	3mg	76%
Selenium	5ug	>100%
Vitamin B12	0.2ug	>100%
Choline	15mg (based on AI)	>100%

Iron and anaemia

Globally, almost one in 10 women of reproductive age have anaemia[108]. In developing countries prevalence rates are higher, ranging between 53.8 and 90.2%[109].

Iron deficiency is persisting despite global efforts and targets to reduce it.

Anaemia in pregnancy impairs physical health, cognitive development, productivity and addressing this is essential to reduce maternal and infant mortality and serious complications[110].

Red meat plays a role in the prevention of anaemia. Pregnant women who consume meat less than or equal to, once a week have over twice the risk of anaemia compared to those who consume it more often[110].

Current dietary recommendations and intakes

According to the National Nutrition Survey[36], 94.6% of women aged 19–30 years do not consume the recommended number of serves of meat and alternatives. For pregnant women, data from the Australian Longitudinal Study on Women's Health shows only 10% meet the recommendations[111].

Furthermore, a systematic review of studies of dietary habits during preconception and pregnancy found pregnant women did not meet iron intake recommendations in 91% of included studies[112].

The role of lean red meat for women of child-bearing age

Lean red meat provides nutrients that contribute to the areas of health and wellbeing in the diets of women of childbearing age as indicated in Figure 10 at the end of this section.

Older adults (65+ years)

The physiological processes associated with ageing influence cognition and memory and increase the risk of developing and living with chronic diseases such as heart disease, cancer and diabetes as well as neurodegenerative disorders and arthritis. These conditions and their risk factors highly influence nutritional requirements with evidence indicating a role for animal derived foods to mitigate some of these challenges.

In Australia, mortality from coronary heart disease is the leading cause of death in older Australians, followed by dementia. The following table highlights the leading causes of death by age groups.[113]

Table 14 Leading causes of death in people aged 65 years and over[113].

	1st	2nd	3rd	4th	5th
65–74	Coronary heart disease **9.4%**	Lung cancer **9.0%**	Chronic respiratory condition **5.9%**	COVID-19 **4.0%**	Leukaemia, lymphomas **7.2%**
75–84	Coronary heart disease **8.9%**	Dementia **8.4%**	Lung cancer **6.1%**	Chronic respiratory condition **5.9%**	COVID-19 **5.3%**
85–94	Dementia **14.4%**	Coronary heart disease **10.7%**	COVID-19 **6.6%**	Cerebrovascular disease **6.5%**	Chronic respiratory condition **3.8%**
95+	Dementia **17.5%**	Coronary heart disease **9.4%**	Cerebrovascular disease **7.2%**	COVID-19 **7.0%**	Heart failure **4.3%**

Cognition

In 2023, 55 million people had dementia worldwide, increasing by approximately 10 million cases each year[114]. Alzheimer disease is the most common form of dementia and may contribute to 60–70% of cases.

In Australia, dementia is the second leading cause of death with provisional data suggesting it will soon be the leading cause[22]. In 2024, it is estimated almost 29,000 people are living with younger onset dementia, and this is expected to rise to almost 41,000 people by 2054[115].

While good nutrition plays an important role in maintaining mental health with age, there is a dearth of evidence in relation to red meat and its role in cognition[116]. One Australian study however found no benefits on cognition and muscle strength in community living older adults when consuming 160g cooked lean red meat on three days a week in conjunction with resistance exercise[117].

Mobility

After the age of 50 years, skeletal muscle mass and strength gradually declines[118]. This results in sarcopenia (aging-related progressive loss of skeletal muscle mass and strength) and is estimated to affect 10–16% of adults aged 60 years and over globally.

Lack of mobility and risk of fails is a major risk factor for hospitalisation and lower quality of life making this an important area to support quality of life and good health during aging.

> **Overall, animal-sourced foods are more effective than plant-sourced foods in improving muscle health and reducing the risk for sarcopenia in adults[118].**

One study that assessed the role of red and white meat in reducing the risk of sarcopenia found consumption of 113 grams five times a week was the optimal dietary intake[119].

One of the reasons even a moderate amount of meat makes a difference to muscle health is its content of essential amino acids, including glycine[120]. Glycine has therapeutic potential in this area and glycine supplementation or feeding animal products with a high glycine content (e.g. gelatin), could represent a simple and effective nutritional strategy as part of a suite of therapies to attenuate sarcopenia[120].

A recent systematic review of beef and its nutrients on health and wellbeing in older adults supports this with the authors suggesting interventions incorporating beef, protein, and amino acids have beneficial outcomes on physical function in healthy older adults aged 50 years and over[121]. Similarly to the area of cognition, they highlighted the need for more research on the effect of beef as a whole food to inform and support future interventions.

Current dietary recommendations and intakes

According to the National Nutrition Survey[36], 80% of women and 77% of men in this age bracket do not eat the recommended number of serves of lean meat and alternatives as recommended in the Australian Guide to Healthy Eating (2 and 2.5 serves daily for women and men 51+ years respectively).

Role of lean red meat in the health and diets of older people

Diets rich in nutrients found in beef such as protein, essential amino acids, vitamin B12, choline, zinc and iron are associated with improved markers of chronic disease[121]. Along with its role in physical and cognitive functioning, red meat is also associated with increased longevity and improved quality of life[121].

Malnutrition is high in older adults with around 50% of those in aged care and in the community either at risk of malnutrition or are malnourished[122]. This affects quality of life and contributes to worse medical outcomes.

Offal such as liver can also play a useful role in enhancing the delivery of valuable nutrients to older adults in particular boosting intakes of vitamin A and iron. Considerations around utilising a blend of regular mince and offal to improve nutrient intakes is highly relevant to this age group.

Lean red meat is a nutrient dense food that fits well within the Aged Care nutrition mantra of 'making the most of every mouthful' – particularly important for older adults experiencing a reduction in appetite.

Lean red meat can play a role in many of the health benefits relevant to the ageing population as outlined in Figure 10 at the end of this section.

Nutrient contribution from lean red meat to older adults

Figure 9 shows the average contribution of lean red meat to daily nutrient intakes for adults 51 years and older.

Overall

Figure 10 on the following page summarises the health benefits of red meat that are linked to it's nutrient content. These health benefits are relevant for many sub-groups across the lifecycle as indicated throughout this section.
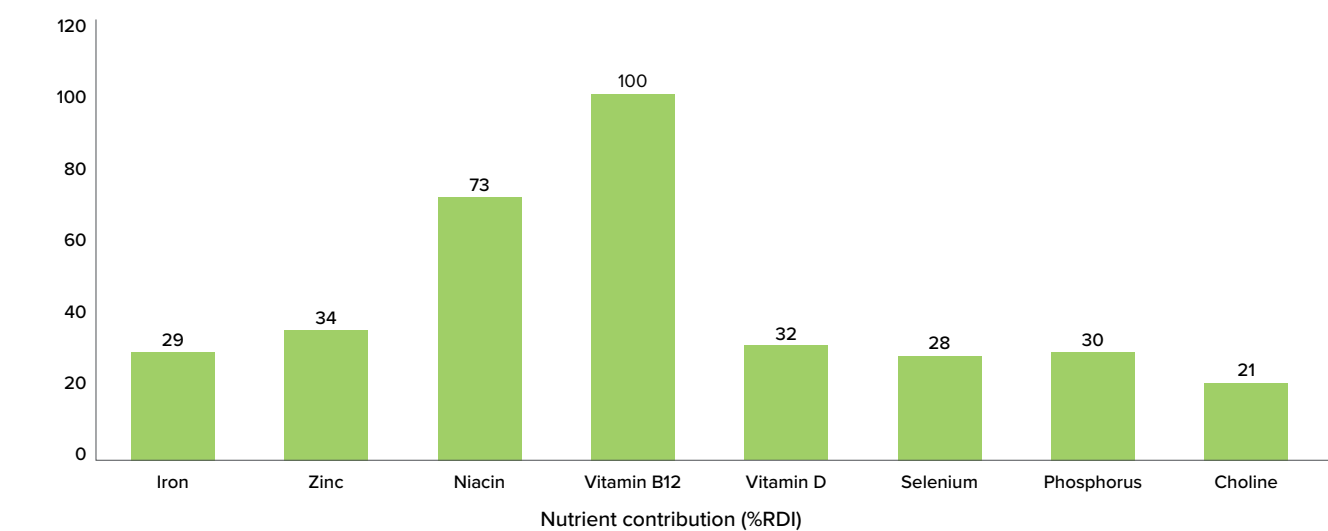

Figure 9 Average contribution of lean red meat to daily nutrient intakes for adults 51 years and older (based on 150g beef mince)

Growth and development: quality protein, vitamins B3 and B12, vitamin D, vitamin E, iron, zinc, phosphorous and selenium for growth and development

Bones and teeth: protein, vitamin D and phosphorous for bones and teeth

Muscle growth and strength: quality protein with all nine essential amino acids plus vitamin D for muscle growth and strength

Immunity: vitamin D, vitamin B12, iron, zinc and selenium for immunity

Brain function, cognition and memory: B vitamins including B3 and B12, iron, zinc, omega-3s and choline for brain function, cognition and memory

Mood: omega-3s and B vitamins including B3 and B12 and vitamin D for positive mood

Nervous system: vitamins B3 and B12 for a healthy nervous system

Energy: vitamins B3 and B12 and iron to reduce tiredness and fatigue

Hair, skin and nails: zinc and the antioxidant selenium help maintain hair, skin and nails

Appetite: quality protein with all essential amino acids to increase satiety

Healthy vision: vitamin A (liver), zinc and selenium as well as omega-3s for healthy eyes, development and maintenance of good vision

Wound healing: protein including the amino acid L-arginine, iron and zinc and vitamin A from offal sources for wound healing

Figure 10 Health benefits for people across the life-cycle linked to the nutrients present in red meat

Section summary

Observations

Red meat provides essential nutrients for growth and development and optimal health and well-being from the first 1,000 days of life through to older adulthood.

Red meat may be particularly valuable in the diets of infants, during pregnancy and for older adults.

There is a lack of evidence for the role of red meat in cognition and muscle strength for older adults.

Implications for red meat

Opportunities exist to highlight the nutritional value of red meat as a solution for common health issues at each life stage.

Additional research is required in the area of red meat, cognition and muscle strength for older adults.

An opportunity exists to further explore the value of red meat as a source of iron for infants, compared to iron fortified cereals.

Recommendations

Commission research into the effects of iron-fortified cereals compared to red meat on infant gut health. Pending results, use to support a campaign on red meat and infant growth and development linked to the importance of good nutrition in the first 1,000 days of life.

Develop and promote 100% pure red meat baby food products for infants.

Broaden understanding and communication around the potential benefits of choline for infant and older adults – particularly around cognition and neurodevelopment.

Seek opportunities in global markets to address the impact of iron deficiency on health and wellbeing for mothers and infants by encouraging more frequent consumption of red meat in this population sub-group. This may best be done via development of nutrient-rich meat based snacks,

Commission research to assess the role of red meat on measures of cognition and muscle strength in healthy older adults, absent of chronic disease.

Develop a red meat/offal blend 'Super Mince' for retail and food service markets that boosts the nutritional intake of the elderly. Market as part of the solution to malnutrition in this age group.

Challenges

Red meat in its raw form can be difficult to chew for older people. Consideration of texture while maintaining appetite appeal is important to encourage consumption.

Offal, particularly liver, can be too high in vitamin A to be suitable for some population sub-groups.

Section 2 – Macro trends and changing consumer behaviour

Global consumer trends

This section provides an overview of the key mega-trends influencing consumers food choices and eating patterns. Three areas are covered:

1. Demographic trends
2. Behavioural trends
3. Health and wellness trends.

Demographic trends

The key demographic trends influencing future food choices and eating habits covered in this section are:

1. Population gowth and urbanisation
2. Ageing population
3. Lifestyle changes

Population growth and urbanisation

By 2050, the world's population is expected to reach 9.7 billion, up from 8.2 billion today with 68% (up from 55%) projected to live in urban areas[123]. The largest growth will occur in Africa and Asia.

Together, India, China and Nigeria will account for 35% of the projected growth of the world's urban population between 2018 and 2050[123]. By 2050, India will have added 416 million urban dwellers, China 255 million and Nigeria 189 million.

Income levels across the globe will also rise and to feed this larger, more urban and richer population, food production will need to increase by 70 percent, including an increase in annual meat production of over 200 million tonnes[123].

Urbanisation leads to changes that influence food demand and choices. These include increased income, smaller family sizes, and higher workforce participation, contributing to decreased time for home food preparation, and increased affordability for purchasing ready-made meals. Urban areas also tend to be the first to experience rapid food systems "modernisation", including penetration of convenience stores and supermarkets, and increased availability of ultra-processed foods[124].

While FAO predicts urbanisation and rising incomes in developing countries will see a shift toward higher-calorie, more resource-intensive foods, including meat, dairy, and processed foods[125], a recent review of changes in Indonesia between 2000 and 2015 found urbanisation was associated with dietary patterns both conducive to increased diet related disease risk and with higher consumption of healthier foods such as vegetables and fish[124]. Consumption of local traditional foods was resilient to urbanisation meaning generalisations about the effect of urbanisation on diets and nutritional health cannot be made.

Locally in Australia, the population of 26.0 million (June 2022) is projected to grow slowly at an annual average of between 1.2% and 1.7% until June 2032. It will reach between 29.2 and 30.8 million people by 2032, and between 34.3 and 45.9 million people by 2071[78]. Australia is already one of the most urbanised countries in the world with 86% of people living in urban areas[126].

Overall, the global population will continue to grow and combined with increased incomes and urbanisation this is expected to increase future demand for meat, especially in developing countries.

Ageing population

Every country across the globe is experiencing growth in both the size and proportion of older people in the population. According to WHO[127]:

- In 2020, the number of people aged 60 years and older outnumbered children younger than five years for the first time.
- Between 2015 and 2050, the proportion of the world's population over 60 years will nearly double (from 12% to 22%).
- By 2030, one in six people in the world will be aged 60 years or over and by 2050, this cohort will double, while the number of persons aged 80 years or older will triple.
- While population ageing started in high-income countries (for example in Japan 30% of the population is already over 60 years old), it is now low- and middle-income countries that are experiencing the greatest change. By 2050, two-thirds of the world's population over 60 years will live in low- and middle-income countries.

In Australia, increasing life expectancy and declining fertility rates are driving population ageing. By 2066, older people will make up between 21–23% of the total population[22]. As at 30 June 2020, one in six were aged 65 and over (15% of the population) and this will increase to 18% within a decade.

Growing numbers of people entering older age means greater demand for foods suitable to their health and nutritional needs providing opportunities for product innovation. Some of these are outlined in section 1 – Older adults.

Marketing considerations

Older adults are highly heterogeneous and people age differently. Distinguishing between aged care, older people receiving home support, and older active people in the community can be useful as their needs are different. The terms 'healthy longevity' and 'healthy ageing' may be useful to consider in marketing to these groups.

Government spending

With more people living to an older age, aged care is one of the fastest growing areas of Australian Government spending and is predicted to increase by 5.7% annually from 2024–25 to 2034–35[128].

Funding for aged care services is the fourth biggest expense program, part of which goes toward the provision of subsidized nutritious meals to allow older people to stay in their homes for longer.

Homebodies

Remote working, increased cost of living, more childless couples, technology and ageing all mean homes are increasingly becoming hubs of health, efficiency and personalised comfort[129]. Globally, people are increasingly becoming 'homebodies'.

With 45% working from home at least once a week, there has been a 30% net shift globally towards consumers eating at home, as opposed to eating out. With less people living 'on the go', more individuals are opting for home-cooked meals or using home meal delivery services.

From 2018 to 2020, the number of Australians using online meal delivery services increased from 3.9 million to 5.5 million[130]. By 2025, the global online food delivery market is expected to be valued at $USD200 billion.

Research shows however that home delivered meals are often nutrient poor and regular consumption is linked to adverse health outcomes prompting some to recommend mandating recipe formulations for the food companies operating in the online food delivery space[131].

Section summary

Observations

The global population is growing, ageing and becoming more affluent.

By 2050, 70% more food will be required to feed the global population.

The population is ageing however different cohorts of older adults will require different food formats.

On average, people are spending more time at home than in the recent past, increasing demand for home delivered meals and groceries.

Implications

The ageing population means demand for foods specifically targeting this population sub-group will grow. It may be useful to consider this market in three distinct categories – healthy longevity (generally well aged adults living in the community), those relying on home delivered meal services (frailer but still living at home), those living in aged care.

Growth in home delivered meals in general can have implications for product formats.

Recommendations

For healthy older people who are living at home, still cooking, but looking for convenience and high nutrition, develop convenience meal solutions that support healthy longevity, and highlight their high quality protein, zinc, choline, iron and natural collagen content.

Specifically developed red meat products that combine beef/lamb/goat with small amounts of liver to develop a 'Super Mince' for older people is relevant. This could be sold through retail and via food service to meet the needs of frailer older people living at home and those in aged care settings (as per previous section).

Semi-prepared meals and products that help consumers make simple everyday meals at home and which are available via home delivery services is relevant.

Behavioural trends

The following section outlines three major behavioural trends linked to changing consumer behaviour and its influence on food and eating habits. These are:

1. Convenience
2. Snacking
3. Cooking and shopping.

Convenience

Convenience food usage has increased 3% globally with developing countries leading the way[132]. India in particular has experienced significant growth showing a spike of 45% in the number of consumers using convenience foods in the 12 months prior to April 2024. The US remains a strong market, with growth also observed in Mexico and Brazil.

In terms of frequency and demand, three in five consumers globally use convenience foods once a week or more, with one in five using them more than once a day[132].

Table 15 outlines drivers and barries to the use of convenience foods.

Table 15 Drivers and barriers to purchasing convenience foods

Drivers	Barriers
Younger demographics	Perceived as being less healthy than home cooked meals
Higher income	Poor value for money
Lack of time and energy to cook	Personal finances
Eating alone	
A balance between convenience and freshness	

Some key statistics:

- Three of the five barriers to choosing convenience foods relate to negative health perceptions (the other two are cost, and a preference for home cooking).
- One third of consumers accept some pre-prepared products in scratch cooking.
- 32% of consumers are cooking from scratch as a method to save money
- Over half of consumers say they would pay more for fresh products, while 18% don't buy convenience foods because the ingredients are not freshly prepared.
- Online shopping is seen as a way to save money on fuel as well as looking for value.

Snacking

Over two-thirds of consumers globally snack at least once a day[133]. Contributing reasons include:

- hunger
- cravings
- boredom – especially when at home
- to feel happiness and comfort.

Key snacking trends:

- A majority of consumers globally buy snacks at a grocery store or supermarket.
- Fruit and vegetable snacks are the top choice for around 60% of consumers globally. This does vary by country however. For example, two-thirds of Brazilian consumers name fruit and vegetables as their top snack while nearly two-thirds of Canadian consumers prefer salty and savory snacks.
- Meat snacks are the fourth leading sub-category within the snacking market[134].
- Healthy snacks are on the rise and are twice as popular as indulgent snacks. One-third of consumers globally say they have increased their consumption of healthy snacks over the past year.
- The increase in demand for healthy snacks has been led by consumers in India and China.
- The top attribute consumers look for in a healthy snack is no additives or preservatives, followed by no artificial ingredients.
- Asia Pacific is the leading region for meat snack launches over the past year[134].
- Source of protein is the leading claim for meat snacks, followed by no additives or preservatives.
- Better-for-you snacks are more likely to be savory versus sweet, with the most popular savoury snack being nuts and seeds.
- Snacking is even more prevalent among children. Seven in 10 global respondents say that their child or children snack at least once a day or more, with the proportion being higher in North America and Asia.

The future of snacking

Future consumer demand for snacks is likely to focus on several key health attributes driven by a desire for wellness, convenience, and personalization. Trends expected to shape the snack landscape are outlined below[135,136,137].

Nutrient dense and functional

High protein will continue to be appealing linked to satiety, muscle health, and weight management, along with snacks containing functional ingredients like probiotics, fibre and antioxidants.

Natural and clean label

Consumer will continue to preference snacks with short, easily recognisable ingredient lists.

Customised nutrition

As personalisation in nutrition technology evolves, consumers will seek snacks tailored to their specific health needs, like improved sleep, energy, cognitive focus, or joint health.

Mood-boosting and cognitive health support

Snacks that support mental clarity, focus, and relaxation will appeal to consumers looking to manage stress and improve productivity.

Nootropic ingredients (cognitive enhancers) like ginseng, L-theanine, or omega-3s, will be incorporated into snacks aimed at boosting cognitive performance.

Enhanced digestive health

Fibre, prebiotics and probiotics will be of interest in snacking to support digestive health and will also be linked to immune function and overall well-being.

Convenient and portable formats

Convenience will remain essential, with consumers looking for snacks that are easy to take on the go and require no refrigeration. Eco-friendly, single-serve packaging that maintains freshness and nutritional integrity will also appeal to environmentally conscious consumers.

These trends reflect a broader shift toward more holistic health and wellness, with a strong emphasis on transparency, personalisation, and nutrient-dense, functional foods that align with individual lifestyle choices. These areas will be covered in greater detail in the Health and Wellness section of this report.

Cooking and shopping

Health continues to drive interest in home cooking as people look to maintain control over what goes into their food.

In Australia nearly half (46%) of consumers are cooking more at home than in previous years having re-discovered a love of cooking following the pandemic[138]. They are seeking to balance healthy eating with convenience and are turning to healthy alternatives to supplement home cooking when they are time poor, rather than resort to take-aways.

> **Almost three quarters of consumers (73%) are putting more effort into maintaining a healthy diet.**

Sourcing local continues to be of interest, particularly as the government review of the food and grocery code of conduct highlighted persistent power imbalances between major supermarkets and their suppliers, and this is driving a desire to connect more directly with food suppliers.

Growing lack of trust in major supermarkets is another factor driving a shift toward more direct online purchasing. McKinsey insights also show social commerce growing with more consumers buying directly through social media platforms. Growth is strongest in emerging market countries such as Brazil, Saudi Arabia and the United Arab Emirates, compared to Europe and the USA.

Section summary

Observations

Convenience continues to grow balanced with ongoing desire for fresh and a preference for home cooked meals to support healthy eating.

People are spending more time at home, using home delivery meals services more, and cooking more at home compared to previous years.

Snacking is moving beyond satisfying hunger to boosting health through functional attributes.

Implications

Meat cuts and pre prepared options that use fresh ingredients will continue to be of interest to health conscious consumers.

Meat based snacks provide an opportunity for innovation in a growth area particularly if they provide functional benefits.

Recommendations

Provide convenience, while also supporting 'scratch' cooking and cooking at home. Solutions that help consumers cut time and effort while still delivering the sensation of freshly prepared food are of interest.

Consider innovation that blends meat-based snacks with functional benefits.
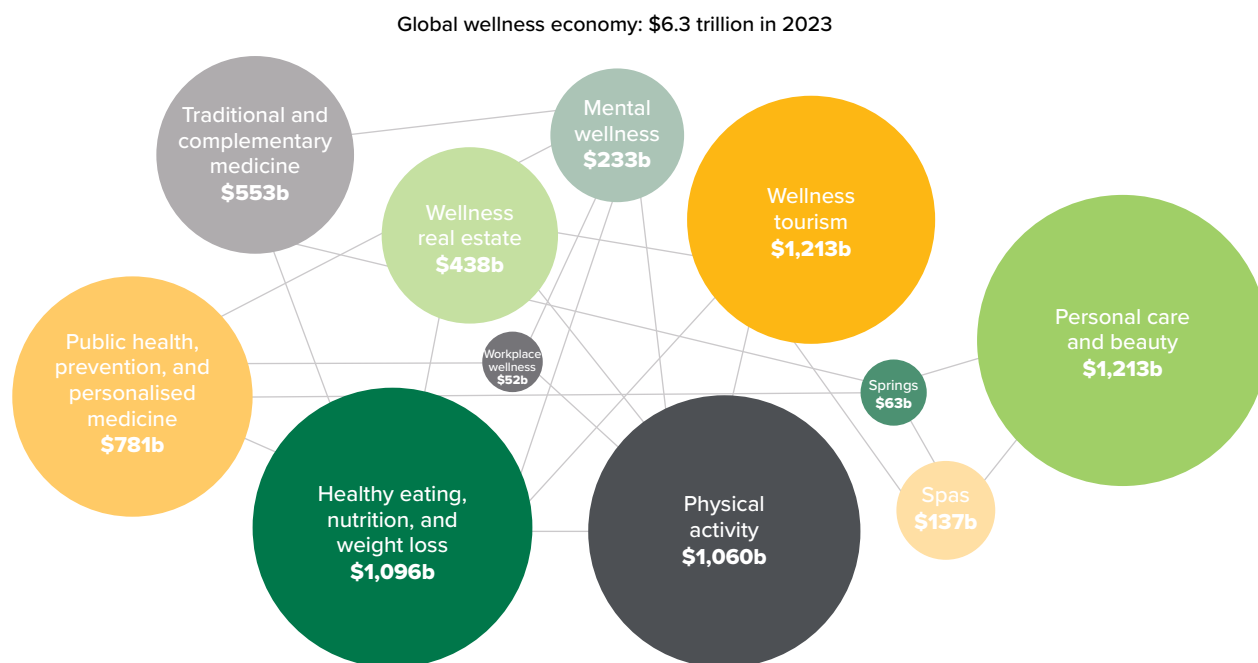
Health and wellness trends

McKinsey estimates the global health and wellness market to be worth more than $1.8 trillion with growth of 5 to 10% annually[139]. Healthy eating, nutrition and weight loss is the second largest category in the market, estimated to be valued at almost $1.1 trillion, coming second to personal care and beauty.

The wellness industry is now roughly four times larger than the global pharmaceutical industry ($1.6 trillion) and nearly 60% as big as all consumer health expenditures ($10.6 trillion)[140].

Overall growth in demand

Growth is occurring in both advanced and emerging markets with an emphasis on the latter. Figure 12 indicates variations in demand across markets.[141]

In emerging markets such as China, India and the Middle East, the percentage of consumers who intend to increase their spending on Wellness products and services is two to three times higher than in advanced markets like Canada and the US.

Global wellness economy: $6.3 trillion in 2023

Note: Numbers do not add due to overlap in sectors.
Source: Global Wellness Institute

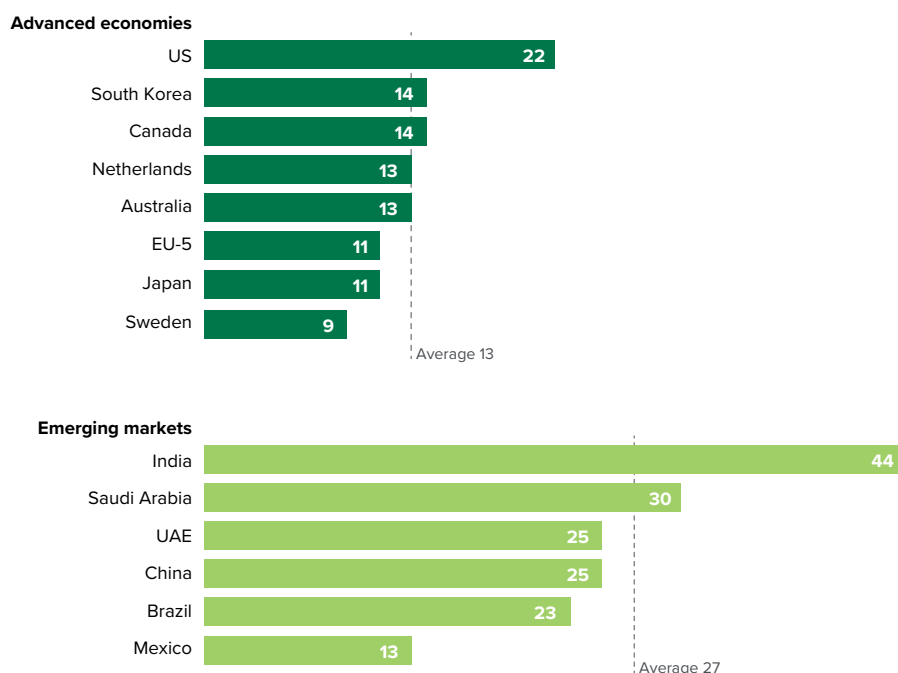**Figure 11** Global health and wellness market categories and their value

Advanced economies

US	22
South Korea	14
Canada	14
Netherlands	13
Australia	13
EU-5	11
Japan	11
Sweden	9

Average 13

Emerging markets

|	
India	44
Saudi Arabia	30
UAE	25
China	25
Brazil	23
Mexico	13

Average 27

Figure 12 Intent to spend more on fitness and wellness, % of respondents[141]

Consistent growth in the Healthy Eating, Nutrition and Weight Loss sector of the global wellness market is predicted. This part of the market is defined as food and beverages that are positioned, marketed and labelled as health- and wellness-enhancing, as well as vitamins and dietary supplements, and weight management products and services. Predicted expenditure up to 2027 is indicated in Figure 13.
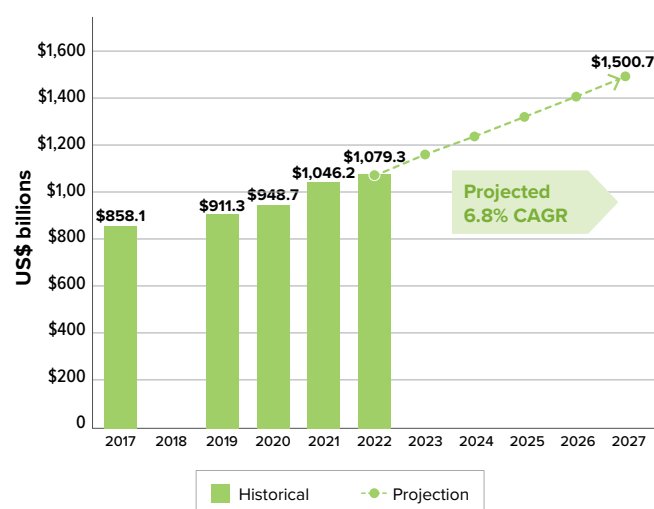
CAGR = Compound Annual Growth Rate
Source: Global Wellness Institute

Figure 13 Global market size and growth projections for expenditure on healthy eating, nutrition and weight loss[142]

The following section expands on three major themes of health and wellness as follows:

1. Personal
2. Functional
3. Natural

Personal

Personalised nutrition aims to preserve or increase health by delivering specifically tailored healthy eating guidance and other nutritional products and services based on individual information. This includes how a person responds to food or nutrients based on their genes and/or current behaviour, preferences, barriers and objectives[143].

Personalised nutrition partially overlaps with related terms such as precision nutrition, nutrigenomics, nutrigenetics, nutritional genomics.

Consumer interest and business estimates a burgeoning potential for this area with demand predicted to reach $550 million by 2030 with around 19% per annum growth[144].

Approximately 20% of consumers in the United Kingdom and the United States and 30% in China look for personalized products and services that use biometric data to provide recommendations[145].

As an emerging field, near term investment is likely to focus more on research and development, proof-of-concept and clinical trials than on commercialisation.

Genetic testing, analysis of the microbiome and advanced technology for wearable devices are three growing areas that feed the development of personalised nutrition.

Genetic testing

Genetic testing involves profiling an individual's DNA and providing a report outlining specific nutrition and lifestyle advice to optimise health based on a person's genetic makeup. DNA results are used to provide information on how the body absorbs and stores nutrients, how best to regulate appetite, and how to eat to reduce disease risk. For example carriers of the FTO gene are known to be at 20–40% higher risk of obesity[146]. This information can therefore be used to tailor a specific diet for weight management. Of relevance, one study found that high dietary protein intake may protect against the effects of the FTO gene on BMI and waist circumference[147] indicating how this data can be used to tailor an appropriate diet.

Microbiome testing

Microbiome testing uses stool samples to map the different types of microbes in the gut and link these with aspects of health. Recommendations for dietary changes are then made based on improving the health of the microbiome (and in turn aspects of a person's health). This can all be done via home testing kits.

Preliminary evidence exists shows analysing the gut microbiome in a stool sample can help predict who will do well on a certain diet[148].

Research is advancing toward a greater understanding of how combining information about the microbiome with other test results, such as genomic tests might help improve people's health however findings are currently not strong enough to be applied in routine health care.

Future applications include assisting people prevent disease and medication side-effects, predict future risk of disease, and assist in the development of a personalised diet for optimal health.

Wearable devices and apps

Wearable devices and apps are advancing beyond basic fitness monitoring to include food and nutrition tracking and feedback. Examples include:

- A Woolworths app linking the Everyday Rewards card with feedback on how closely a person's shopping basket aligns with the Australian dietary guidelines. Feedback is given on which foods to enjoy in moderation and those to eat more of along with suggestions about healthier swaps to improve the nutritional value of the weekly grocery shop.
- GoBe3[149] – a smart band that tracks calorie intake, body hydration, and neural activity automatically without manual logging. It uses an advanced algorithm to provide macronutrient breakdowns, based on detecting a person's blood glucose curves after eating.
- Miniature tech – including wearables that mount on the teeth and monitor saliva flow. This technology has potential value for monitoring blood glucose levels and for testing for a variety of health conditions[150].

Useful statistics[151]:

- 67% of Indonesian consumers have tried/ would be interested in trying food or drink personalised to match their needs.
- 52% of Indian consumers agree tracking health factors, such as diet and exercise, helps keep oneself motivated.
- 30% of consumers globally are willing to pay for personalised nutrition services at an average premium of 50% relative to non-personalised nutrition products and services[144].

In the next five years, consumers will look for trustworthy education and recommendations for products that give them the ideal nutrient balance based on their age and health status[152]. Food producers will need to partner with technology companies to create solutions that meet their needs.

The role of meat in personalised nutrition

Individuals who carry certain genes may benefit from regular inclusion of red meat more than others. Identifying genetic profiles that map to higher protein intakes will influence future food marketing.

Three relevant examples:

1. Individuals carrying the APOE4 gene are at increased risk of developing Alzheimer's Disease[153]. Higher protein intake could benefit cognitive health in those carrying this gene[154]. Red meat, being high in protein, may therefore be useful in the diet for these people.
2. Individuals carrying the FTO gene are at increased risk of high BMI and waist circumference[146]. Higher protein intake could be beneficial indicating a role for red meat in personalised weight management for these people.
3. Individuals carrying the MTHFR gene or FUT2 are likely to benefit from increased intake of vitamin B12 from food or supplements[155], and red meat is naturally a good source.

Section summary

Observations

The science to support the use of genotype and microbiome testing to inform dietary decisions is advancing. There is strong consumer interest in more personalised recommendations regarding diet and health.

Technology is advancing and shifting dietary decision making away from the traditional model of seeking advice from a healthcare professional and into the hands of algorithms.

Implications

Personal testing and advice will dismantle the one size fits all approach to dietary advice. Awareness of this is useful for future marketing and innovation.

Future product development may be done with genetic profiles in mind.

Data about nutrients and bioactive compounds in meat that support health and wellness may be of increasing interest and value in the future.

Recommendations

Monitor research in this area to enable the matching of certain nutrient bundles within red meat to be appropriately recommended to those with certain genetic profiles.

Shift focus to the individual rather than a "one size fits all" approach to nutrition and dietary advice Seek ways to communicate to consumers that the product is "designed for me". For example, "Iron, zinc and vitamin D: "For people carrying XYZ gene.".

Research opportunities – keep abreast of and engage with research to better understand the interactions between genes and food.

Start building a database of red meat components that benefit certain genotypes and microbiome types to prepare for the future.

Challenges

Excessive focus on personalisation may create a barrier to sharing meals and families eating together, therefore negatively impacting social and cultural health and wellbeing.

Concerns about ethics and a person's 'need to know' may represent barriers to widespread adoption of genetic testing.

Research exists linking red and processed meat intake to increased risk of diseases, most predominantly colorectal cancer risk via effects on inflammatory and DNA repair pathways. Awareness of ongoing research in this area is essential to provide informed advice around the role of red meat in personalised diets in the future.

Functional

This section outlines functional food trends and matches them to bioactive compounds found in red meat to identify innovation and marketing opportunities.

Functional foods are those that have health effects in the body over and above the delivery of nutrients. They appeal to consumers who seek out health practises to support the betterment of mind and body.

Bioactive compounds are chemicals found in small amounts in foods and plants that have Recommendations in the body that promote good health. Examples of bioactive compounds in meat include vitamins, minerals, fatty acids, amino acids, L-carnitine, taurine, conjugated linoleic acid, glutathione, alpha-lipoic acid, collagen and bioactive peptides.

All aspects of the carcass, including connective tissues, bones, hides and skin, contain some of these valuable bioactive compounds which in turn are suitable for inclusion in functional foods and nutraceutical supplements.

Areas of high level interest to consumers where functional foods that contain bioactive components found in red meat can potentially play a role are outlined in this section and include:

1. Gut health
2. Skin health – ageing
3. Joint health
4. Sports performance
5. Heart health
6. Weight management
7. Cognitive health – mood
8. Cognitive health – ageing
9. Immune health

Gut health

Trends

Gut health is one of the strongest trends to affect the food industry in recent years driven largely by the fact 40% of the global population suffer from at least one functional gastrointestinal disorder[156]. Three in five US adults now try to eat foods that encourage a healthy gut microbiome[157] as research continues to support the role it plays in gut health and beyond.

Components of food that predominantly influence the gut microbiome are dietary fibres, prebiotics and probiotics.

Red meat and gut health

Current research indicates a paucity of well-designed studies assessing associations between meat intake and the microbiota[158,159].

Indirectly, meat may influence the microbiome by providing nutrients such as protein, choline and iron, that are available after digestion for further metabolism by gut bacteria. Amino acids for example that are derived from animal products can be metabolised by gut bacteria to produce branched-chain amino acids that could play a role in reducing the risk of type 2 diabetes[160]. Like fibre fermentation, protein fermentation produces beneficial short chain fatty acids, however in lower quantities.

Some studies have demonstrated moderate meat consumption, and its proteins positively affect the gut microbiome in infants[161].

The link between red meat and colorectal cancer is a broader gut related issue that may impact the industry's ability to play in this space. The World Cancer Research Fund has classified beef, lamb and pork as group 2A carcinogens indicating they are probably carcinogenic to humans[162] and this likely creates an overarching challenge in how to communicate the role of meat in a healthy microbiome.

Fermented meat

Despite the above, one promising area may be fermented meat. Naturally fermented meats, produced by traditional methods have the potential to be explored in the production of functional meat products as they provide a relevant matrix for the delivery of probiotics[163].

Fermented meats have health advantages compared to processed meats, as they are made through a natural process that preserves the meat and enhances its flavour without the addition of preservatives such as nitrates and nitrites. They may also have higher concentrations of vitamins and minerals, such as B vitamins and iron.

Skin health – ageing

Trends

Healthy ageing is one of the top benefits consumers seek from food, beverages and nutrients with a key aspect of this being the desire for foods that assist to reduce the signs of ageing through preservation of skin health[164].

Foods that assist with maintaining healthy skin with age will continue to be of interest within the context of an ageing global population.

While anti-ageing has been a popular term in marketing of foods for healthy skin, there is a general shift in consumer preference to the more positive term of 'well ageing'[165]. Consumers are now more interested in embracing and appreciating all stages of life, rather than 'battling' the natural signs of ageing.

Red meat and skin health

Collagen is one of the key components of red meat that plays a role in skin health. Collagen powders, bone broths and bars are all familiar innovations to the industry.

Additional nutrients found naturally in red meat that are also relevant for skin health and which have pre-approved general level health claims allowed locally by the Food Standards Code, include zinc, iodine, niacin and vitamin A (present in offal).

The scientific support for collagen in skin health (and other areas) has been developing steadily over the past 10 years with 24% of all notified health claims submitted to FSANZ being for the health benefits of collagen (as at the time of writing).

Market demand

The global skin health foods market was valued at USD1.91 billion in 2021 and is expected to grow at a CAGR of 6.5% up to 2030[166].

Skin health is the third most prevalent problem consumers seek treatment solutions for (ranking behind weight management and stress and anxiety[167].

Joint health

Trends

The key driver for functional foods linked to joint health is the rising prevalence of conditions such as osteoarthritis, increasing in line with the global trends of ageing and obesity. The joint health market is also supported by health-conscious 'baby boomers' and 'Gen-X' consumers who wish to maintain joint health to proactively maintain quality of life.

According to Arthritis Australia, in 2025, 4.1 million Australians will have arthritis, increasing to 5.39 million by 2040 – a 31% rise with population growth. By 2040, arthritis will affect over 2.1 million men and over 3.2 million women with osteoarthritis being the most common type[168]. In addition, 70% of older adults report currently experiencing joint pain.

Red meat and joint health

Components of red meat that can assist with joint health include protein, vitamin D and potassium, for their link to muscle strength and function, omega-3s for their anti-inflammatory benefits and the bioactive compounds collagen and chondroitin sulphate. Collagen contains biologically active peptides that can reach joint tissues and exert protective effects.

Chondroitin sulphate is a natural compound found in the cartilage of joints which contributes to the resilience and elasticity of cartilage, helping to maintain its structure and function. Chondroitin sulphate has a history of use as a dietary supplement, particularly in combination with glucosamine, to help manage symptoms of osteoarthritis which is characterized by cartilage degeneration.

Chondroitin sulphate has been shown to slow down the progression of osteoarthritis through numerous mechanisms of action[169] and to reduce joint pain[170].

A review of chondroitin sulphate commissioned by MLA in 2005 concluded there is a substantial opportunity for Australian meat processors to supply an international market with a reliable source chondroitin sulphate from a defined and sustainable animal source.

Of note however is that Arthritis Australia currently state the evidence to support chondroitin in managing arthritis is mixed[171].

Market demand

The global market for joint health supplements was estimated at USD3.90 billion in 2023 and is expected to grow at a compound annual growth rate of 7.26% from 2024 to 2030[172].

Sports performance

Trends

There is a significant rise in interest in fitness by young people with 30% of Gen Z (those born 1997–2012) working out in fitness facilities compared to 15 to 25% of the average adult population (US research)[173].

Trends locally show the number of young people (15–17 years) meeting the physical activity guidelines in 2022 was double what it was in 2017–18, with young males almost three times as likely to meet the physical activity guidelines as young females[174]. In addition, one in four (22.4%) of adults aged 18–64 years met the physical activity guidelines in 2022, an increase from one in six (17.0%) in 2017–18.

Food plays a major role in providing the energy to fuel sports performance and physical activity, and to support muscle health and recovery.

Red meat and sports performance

Red meat contains many nutrients that support sports performance including high quality protein, iron, zinc, vitamin D, B vitamins, potassium and selenium. It also contains L-carnitine and creatine, a substance that plays a role in the energy system responsible for producing power.

Meat is the primary source of creatine in the diet and research shows supplementation may enhance exercise performance in individuals requiring maximal single effort and/or repetitive sprint bouts[175]. It is quite safe to consume at recommended doses (generally 5–20g a day)[176,176].

L-carnitine, an amino acid involved in energy production and fatty acid metabolism, may also help improve some aspects of exercise performance[177].

A review of beef protein and its benefits for exercise performance found beef protein provides similar effects to whey protein in relation to body composition and, compared to no protein supplementation, might be an effective intervention to increase total daily protein intake, lean body mass and lower-limb muscle strength when used on conjunction with exercise training[178].

Market demand

The global sports nutrition market size was valued at USD45.24 billion in 2023 and is expected to expand at a compound annual growth rate of 7.5% from 2024 to 2030[179].

Heart health

Trends

Heart disease is the world's biggest killer, responsible for 13% of total deaths globally and since 2000, the largest increase in deaths has been for this disease.

Consumer research indicates 63% of global consumers are interested in heart health products even if they don't suffer specific health problems[180]. This is characteristic of the post-pandemic era where a more proactive approach to health is being taken.

Red meat and heart health

Red meat contains omega-3s which have been linked to heart health. It also contains Coenzyme Q_{10} (CoQ_{10}), taurine and L-carnitine which may have heart health benefits[181]. It occurs in high concentrations in the liver, heart, and kidneys, making these animal organs a good source.

Research shows CoQ10 plays a role in protecting the body from disease conditions, with the strongest evidence in cardiovascular disease, particularly in the treatment of heart failure[182].

Taurine is a naturally occurring sulphur-containing amino acid, that may have beneficial heart health effects, including blood pressure regulation, improved cardiac fitness, and enhanced vascular health[183].

L-carnitine may also play a role in heart health[184].

Market demand

The global market for cardiovascular supplements was estimated at USD10.88 billion in 2022 and is projected to grow at a compound annual growth rate (CAGR) of 9.06% from 2023 to 2030[185].

Weight management

Trends

Weight management is the number one problem consumers seek solutions to help treat or prevent[168].

Along with the ongoing global increase in prevalence of overweight and obesity, Mintel's 2025 food and drinks trend report highlights the additional influence in this space of new drugs available to treat obesity that are gaining in popularity and include brands such as Ozempic and Wegovy. These drugs work as appetite suppressants, reducing food intake and assisting blood glucose management via weight loss and due to significant demand locally and globally, both are currently in short supply.

Launched initially in the USA, one in eight adults have now used one of these medications at some point in their life, and half – or more than 15 million people – are currently using a prescription[186]. At least 25,000 people are starting Wegovy each week.

The emergence of these weight loss medications and their broad reach and appeal opens a market opportunity for development of functional and nutrient dense foods to help consumers meet nutritional needs while eating less food.

Despite this, US research shows only one in four people would rather take a medication than change their lifestyle[165].

Red meat and weight management

As a protein rich, nutrient dense food, red meat can assist with weight management by contributing to satiety, while assisting consumers meet recommended nutrient intakes. In addition to protein, meat also contains L-carnitine, an amino acid that contributes to energy production and fatty acid metabolism.

Several comprehensive reviews have found L-carnitine supplementation has a modest reducing effect on body weight, BMI and fat mass, especially among overweight or obese adults[187,188]. The effect size was a reduction of 1.2–1.3kg of body weight with around 2000mg of L-carnitine per day having maximal effects.

Bioavailability of L-carnitine from food sources is also significantly better than L-carnitine from dietary supplements[189].

Collagen peptides may also play a role in weight management[190].

Market demand

The market size for weight loss products was valued at USD142.1 billion in 2022 and is projected to grow to USD407.9 billion by 2030, exhibiting a compound annual growth rate of 16.26% during the forecast period (2023–2030)[191].

Cognitive health – mood

Trends

Demand for foods that improve mood and assist with relaxation is strong as the global burden of disease linked to stress and anxiety is increasing.

In Australia, nearly half the adult population (42.9%) have experienced a mental health disorder at some time in their life and one in five have a 12-month disorder, with anxiety being the most common[192].

In the US this year nearly two in three consumers report feeling very or somewhat stressed, with "managing personal finances" being the main factor, followed by "the economy in general". Three in four say food choices impact their mental well-being and two in three recognize the reciprocal relationship: their mental well-being has on the food choices they make[165].

Globally, anxiety has had an impact on the lives of 73% of consumers in the past few years and they are turning to retail for small doses of happiness[193]. There is strong interest in products that provide relief from stressful emotions through the experience they bring, feel good marketing and/or the provision of functional benefits that help improve mood.

Red meat and mood

In general, mood foods are those that combat inflammation and promote overall wellbeing with omega-3s, essential amino acids and B vitamins playing a role, all nutrients that are found in red meat. Research also shows creatine, found naturally in red meat, may help improve mental health conditions such as depression and anxiety[194].

Market demand

Dietary supplements positioned around mood support, stress, or relaxation have been accelerating since the onset of COVID-19. Global sales of mood supplements alone in 2022 were USD656 million with 6.4% projected growth between 2023–2033 and a total estimated value of USD1.3 billion by the end of 2033[195].

Cognitive health – memory and ageing

Consumer interest

In the context of an ageing population and the rise of Dementia as a leading cause of death and disability, food products that assist to preserve brain health, including memory, cognitive ability, concentration and attention will continue to grow.

Nootropics which are substances in food that act by improving memory, creativity, motivation or attention are of particular interest, along with antioxidants that play a role in reducing brain oxidative stress, one of the key contributors to the structural and functional changes observed in the ageing brain[196].

The emerging field of Nutritional Cognitive Neuroscience is using various images of the brain, along with nutrient biomarkers to assess brain health in older adults and linking this to diet. To date, different brain types have been identified, including a Delayed Brain Aging Phenotype with analysis of dietary biomarkers showing a link with higher concentrations of specific fatty acids, antioxidants, and vitamins including omega-3s, vitamin E and choline[197].

In addition to this emerging research, many nutrients are needed in adequate amounts to perform essential functions linked to the maintenance of psychological and nervous system function, including iron and zinc. There is also evidence that vitamin B12 and choline, play a role in arresting cognitive decline with age[198] along with L-carnitine[199].

A range of key nutrients improve brain health and mental function via their effects on brain plasticity, neuronal function, and cognition[197].

Red meat and cognition

Red meat is a natural source of many nutrients linked to preserving brain health with age.

*B-vitamins which might delay or arrest the cognitive decline of older adults[200].

*Vitamin B12 which can enhance cognitive performance by ensuring proper brain function. Vitamin B12 deficiency has been associated with structural and functional brain changes[201].

*Choline – which is associated with improved cognitive function and delayed cognitive decline[202]. Choline is currently being investigated for its potential role in Alzheimer's disease and liver is one of the richest sources of choline.

*Selenium – which has antioxidant and anti-inflammatory activity with neuroprotective effects[203].

Zinc – which deficiency is associated with cognitive decline in older adults[204].

Vitamin E – the antioxidant activity of vitamin E helps support cognition and brain plasticity[205]. Liver is particularly high in vitamin E.

Vitamin D – deficiency is a risk factor for dementia, Alzheimer's Disease and cognitive impairment[206] and vitamin D supplementation, especially in those with deficiency has a positive effect on cognition[207].

Omega-3s – sufficient intake of omega-3s is associated with better learning, memory ability, cognitive well-being, and blood flow in the brain[208].

*Creatine – research indicates creatine may help boost memory, concentration and information processing speed[209]. Preliminary studies also suggest creatine supplementation has the ability to increase brain creatine content in humans which in turn may enhance cognitive function, address neurodegenerative diseases and support mental health[195].

*L-Carnitine – evidence suggests L-carnitine may have a role in slowing the progression of Alzheimer's disease[210].

*Typically, higher in offal compared to muscle meat.

Market demand

The global brain health functional food and beverage market size was valued at USD18.10 billion in 2022 and is expected to grow at a compound annual growth rate of 10.5% from 2023 to 2030[211].

Immune health

Trends

Globally, consumers are prioritizing immune health with 61% taking some action to protect their immunity in the past year (2024). People in Indonesia, Brazil and India are the most interested in immune health. It is also of high interest to Millenials and for baby and toddler foods which have lead the way in food and beverage launches with immune health claims in the past year.

Vitamins and protein are key ingredients consumers look for to support immune health claims, with 42% of Indonesian consumers looking to boost protein intake for immunity, nearly double the global average of 23%[212].

Red meat and immune health

Red meat contains a variety of nutrients that have immune health benefits. These include protein, vitamin A (liver), vitamins B6, B12, D and folate, zinc, iron and selenium. All these nutrients are linked to pre-approved claims for immune health in the Australia New Zealand Food Standards Code meaning immunity related claims can be made for red meat products locally that meet the conditions for these claims, without additional innovation.

Market demand

Consumers increasingly recognize the link between protein intake and immune health, creating opportunities to highlight the protein content of red meat and it's vitamin and mineral content with immune benefits.

The global immunity boosting food products market was valued at $24.86 billion in 2023 and is expected to grow at a CAGR of 9.7% to reach $60.77 billion in 2033[213].

Section summary

Observations

There are significant opportunities to link red meat, it's nutrients and bioactive components to functional health benefits that appeal to consumers globally.

Challenges exist with red meat entering the gut health space however fermented meat may be a way forward.

There are many bioactive compounds in red meat that provide health benefits relevant to future consumer demands.

Red meat is well positioned to take advantage of growing consumer interest in brain health and cognition through its content of nootropic substances and natural nutrient content.

Implications

A variety of opportunities exist to develop combinations of bioactives and nutrients to target various areas of health and wellbeing.

Plant-derived nootropics with documented evidence of effectiveness in cognition provide opportunities to pair meat and meat-products with these components

Recommendations

Explore the potential for fermented meat as a matrix for the delivery of beneficial probiotics that can play a role in gut health via positively influencing the gut microbiome.

Consider involvement in research to better understand the direct impact of lean red meat and its components (including iron, protein, amino acids and choline) on the gut microbiome.

Invest in the development of systematic reviews to substantiate general level health claims for industry use that are linked to bioactives and nutrients in meat. For example, collagen and skin health, creatine and muscle strength, protein and satiety, L-carnitine and weight management.

Combine bundles of natural nutrients and bioactives to develop products with benefits for growth markets e.g. Healthy Longevity – supported by protein for muscle strength, collagen for skin and chondroitin for joints.

Build the science to support nootropic substances in meat and their role in cognition and mental health, include choline, L-carnitine and creatine.

Target older adults with products focused on enhancing quality of life through better brain health as an opportunity that combines several key trends.

Match consumer trends with macro trends and the nutrient and bioactive profile of red meat to identify key opportunities for future focus (see Section 3).

Challenges

Managing the historical link between red meat and risk of colorectal cancer.

Differentiating between processed meat and fermented meat for consumer acceptance and understanding.

High salt content of fermented meats which can contribute to hypertension if consumed in excess.

Claims in the nootropic space need to be backed by scientific evidence to generate consumer trust. For some nootropics, the evidence for specific benefits is still building. Timelines for product innovation may be lengthened while scientific evidence builds to support claims.

Development of systematic reviews for food-health relationships if the claim is outside currently established general level health claims set out in Food Standards Code will add to product development timelines.

Lack of regulation of nootropic components such as safe levels in foods and supplements creates a potential obstacle.

Evidence for many nootropics is short term focusing on the acute effects of these substances. Knowledge of longer term effects of ongoing consumption is limited.

Natural

Consumer interest in protein rich foods, functional foods and nootropics is strong however is overlaid with a preference for fresh and natural foods to deliver these benefits.

The clean label trend, which has persisted over recent years, is one indicator of this preference. While in the past the nutrition information panel was the primary source of information about the health attributes of a product, today consumers look more closely at a products ingredient list and make choices accordingly.

This trend will continue gaining momentum as research and public health attention builds around the significant health risks linked to diets high in ultra-processed foods (UPFs).

Researchers have developed various systems to classify the degree of processing a food undergoes with the most popular being the Nova system[214].

The four categories in this food classification system are outlined in Table 16.

As indicated in Table 16, UPFs are industrially manufactured products that contain minimal whole food ingredients and are often rich in additives. Many protein bars, snacks, beverages and meat alternative products are classified as UPFs. It is this category of foods within the Nova system where research is indicating health risks.

For example, a 2024 review associated high UPF intake with a greater risk of 32 health issues, including heart disease, cancer, obesity, digestive and mental health disorders[215]. Due to their composition, these foods have been found to contribute to inflammation, insulin resistance, and poor metabolic health.

The strength of the research is now leading to calls for policies to limit UPF consumption, recommending clearer labelling and reduced marketing to improve public health.

Currently however, the preference for less processed foods is occurring alongside rising living costs and while there is a desire to eat less processed foods, most consumers aren't willing to pay more.

Balancing cost and health, many consumers are defining their own boundaries around what is an acceptable and unacceptable level of processing and most agree that highly processed foods are acceptable in moderation within a balanced diet.

Linked to this is that for the third straight year in the *IFIC Food & Health Survey*, "fresh" is the most common criteria used by consumers to define a "healthy" food followed by "good source of protein" and "low in sugar"[165]. While the inclusion of "fresh" and "low in sugar" in definitions for "healthy" have remained consistent across the last three years, "good source of protein" is gaining steam, steadily climbing over the past three years. Applying a good source of protein claim to a fresh food such as meat makes good nutritional sense, appealing to two key consumer health related trends.

Table 16 The Nova Classifications of Processed Foods

Group	Definition	Examples
Group 1 – Un-processed or minimally processed foods	Edible whole foods; spring and tap water; dried, frozen, boiled or pasteurized unprocessed foods.	Fresh meat, fresh, frozen or dried fruit and veg; rice, corn, eggs, nuts, herbs, plain yoghurt.
Group 2 – Processed culinary ingredients	Substances obtained from group 1 foods or from nature using industrial processes such as extracting, refining or pressing. Foods used to prepare, season or cook group 1 foods.	Seed, nut or fruit oils, butter, lard, cane sugar, honey, maple syrup.
Group 3 – Processed foods	Products made by adding salt, sugar or other group 2 foods to group 1 foods using preservation methods such as canning, bottling or fermentation.	Smoked or cured meats; canned or bottled vegetables; legumes in brine; salted nuts; canned fish; fruit in syrup.
Group 4 – Ultra-processed foods	Formulations of ingredients, made by a series of industrial processes, many requiring sophisticated equipment or technology. Processes used to make ultra-processed foods include fractioning whole foods into substances, modifying food substances using industrial techniques and using additives at various stages of manufacture.	Many ready to eat products such as meat substitutes, carbonated soft drinks; sweet or savoury packaged snacks; confectionary; ice-cream; energy bars, pastries, cakes, instant sauces.

Section summary

Observations

Consumers define healthy foods as fresh and natural and have a preference for these over ultra-processed foods in their diet.

Despite this preference, most are not willing to pay more for fresh and natural and are finding their own balance around acceptable amounts of processed foods in their diet.

Implications

A preference for fresh and natural provides a benefit for the red meat industry where innovation is based on fresh meat, linking health benefits to the whole food.

Recommendations

Emphasise red meat as a whole, natural and fresh product.

Aim to minimise processing where innovation relies on it, for example, in the development of meat based snacks.

Naturally derived ingredients are preferable to consumers keen to avoid over-processing. This provides a key point of difference for substances such as nootropics that can be naturally derived from meat.

Monitor the research on UPFs and utilise the connection between these foods and poorer health outcomes as a marketing message to support fresh red meat consumption.

Continue to link claims such as 'good source of protein' with fresh red meat to appeal to consumers preferences to eat whole, fresh foods to support good health and wellbeing.

Section 3 – Innovation, interpretation and recommendations

Interpretation of the research and insights included in the report, along with priority recommendations for communication and innovation are outlined in this section. Table 17 provides an analysis of macro-trends, consumer trends and lifecycle groups against the strength of communication opportunities, the ease of product innovation and the value and growth of each market. An opportunity score is provided based on the analysis.

Table 17 Analysis of trends against communication, innovation, value and growth

Area	Public health priority? √ = Yes/X = No	Link to a consumer trend? √ = Yes/X = No	Communication opportunity? Strong/Medium/Weak	Ease of innovation? Easy/Medium/Hard	Value* ($USD)	Growth* %CAGR to 2030	Opportunity score**
Macro-trend: Overweight and obesity							
Weight management	√	√	M	E	$31.4b	16.2%	15
Macro-trend: Non-communicable diseases							
Heart disease	√	√	M	H	$10.9b	9.1%	11
Dementia	√	√	S	E	$18b	10.5%	15
Joint related diseases	√	√	S	E	$3.9b	7.3%	13
Stress and anxiety	√	√	W	H	$605m	5.5%	8
Diabetes	√	X	W	H	$13b	5.9%	6
Cancers	√	X	W	H	$2.1b	8.1%	7
Macro-trend: Ageing population							
Heart health	√	√	M	H	$10.9b	9.1%	11
Cognitive health	√	√	S	E	$18b	10.5%	15
Joint health	√	√	S	E	$3.9b	7.3%	13
Skin health	√ (for skin cancer prevention)	√	S	E	$1.9b	6.5%	13
Lifecycle related							
Infant nutrition	√	√ Immunity	S	E	$4.5b RTE baby foods	5.5%	13
Toddlers	√	X	S	E	$2.35b	7.5%	11
Children and teens	√	√ Mood	S	E	Undefined	Undefined	10+
Women of child-bearing age	√	X	S	E	$542m Prenatal supplements	8.5%	10
Older adults	√	√	S	E	$25.3b Elderly nutrition market	6.7%	14
Other							
Malnutrition	√	X	S	E	n/a	n/a	7+
Personalised nutrition	X	√	S	H	$10.5b	16.5%	12
Sports performance	X	√	S	E	$45.2b	7.5%	14
Immune health	√	√	S	E	$26.6b	10.7%	16
Gut health	X	√	W	H	$51.6b	8.3%	10

*Note the figures for value of the market and %growth are indicative only. They are primarily used for comparison purposes in the analysis.

**Key to scoring: For public health priority: Yes = 1 / No = 0 . For consumer trend links: Yes = 3 / No = 0. For communication opportunity: Strong = 3; Medium = 2; Weak = 1. For ease of innovation: Easy = 3; Medium = 2; Hard = 1 For value: >$20 billion = 3; >$1-20billion = 2; <1 billion = 1. For growth: 10+% = 3;7.5-9.9% = 2; 5-7.4% = 1

Results – priority innovation opportunities

Using the scoring in Table 16 as a guide, the following priority areas for innovation arise.

1. Immune health
2. Weight management
3. Cognitive health/dementia/older adults – healthy longevity

Second tier priority areas:

4. Sports performance
5. Skin health
6. Joint health

Table 18 below expands on these innovation opportunities.

Table 18 Top priority areas for innovation

Area	Components naturally present in red meat supporting benefit	Formats	Markets	Regulatory considerations
Top priority opportunities				
Immune health	Vitamin A (liver), vitamins B6, B12, D and folate; zinc, iron and selenium.	Immediate: Fresh formats with allowed general level health claims linked to the nutrients naturally present. Bone broth powders. Medium: blended fresh formats incorporating liver with beef/lamb/goat to add vitamin A. Longer term: snacking formats such as dehydrated meat with added offal.	Following the global pandemic, immune health is a consumer benefit that has broad appeal across markets. Research suggests people in Indonesia, Brazil and India are the most interested in immune health. Health-conscious consumers.	The nutrients listed in column 2 all have pre-approved general level health claims that link to immunity in the Australia/New Zealand Food Standards Code. These claims can be used on meat products now (confirm with testing on particular meat cut). Vitamins and minerals cannot be added to meat based snacks or other meat products currently. Consider a submission to change this in the Food Standards Code.
Weight management	L-carnitine, protein, nutrient density of lean meat.	Immediate: Portion controlled fresh formats highlighting protein. Medium: Meat protein powder meal replacement products. Medium: High satiety meat based snacks enriched with L-carnitine.	Weight management is relevant across most markets locally and globally. 45% of people globally are currently trying to lose weight.	Communication is limited by lack of weight related claims allowed in the regulations. Development of two systematic literature reviews is recommended to support a health claim for meat protein and satiety and one for L-carnitine and fat metabolism.
Cognition – ageing	B vitamins (folate, B6, B12), choline, selenium, zinc, vitamin E, vitamin D, omega-3s, creatine, L-carnitine.	Fresh formats (blended products to reach specific nutrient targets). Suggest the development of a "Super Mince" for sale through retail and food service – see markets.	Well people 55+ years living in the community – sold into retail. Marketed with the positioning of 'Healthy Longevity'. Older people living at home receiving home delivered meals and aged care settings – product sold into foodservice as a solution to malnutrition in aged care and older community living adults.	Many of the nutrients listed can be linked to health related claims about cognitive health. Medium term considerations are to develop a systematic literature review to enable cognitive health claims specifically linked to the ageing brain to enable a more specific health claim of appeal to the market.

Area	Components naturally present in red meat supporting benefit	Formats	Markets	Regulatory considerations
Second tier opportunities				
Sports performance	Creatine, protein, B vitamins, iron, glycine.	Immediate: Sports specific protein powders. Medium term: Fortified snacking formats for on the go consumption.	Gen Z – younger, active people, gym goers, serious athletes and health-conscious recreational athletes.	These products can be developed under the Food Standards Code classification for sports specific foods.
Skin health	Collagen, zinc, protein, niacin, vitamin A (liver).	Snack bars for on the go consumption.	Emerging – China, India, Middle East and local young, beauty conscious women. Middle to older aged women looking to reduce the signs of ageing skin.	Nutrients naturally present in meat listed in column 2 can be linked to skin health claims now. To make a claim about collagen and skin health and systematic literature review needs to be done and submitted to FSANZ.
Joint health	Chondroitin sulphate, glucosamine, collagen, protein, vitamin D, omega-3s.	Immediate: Fresh meat products blended to achieve nutrient targets. Medium term: small format snack bars.	Middle to older aged consumers concerned about preserving or improving joint mobility. 3.7 million Australians living with arthritis. 1 in 3 Americans have experienced some joint discomfort. People looking to stay active for longer – "healthy longevity' positioning.	Claims can be made linking vitamin D and protein to bone health and muscle health. The presence of chondroitin, collagen, glucosamine and omega-3s can be highlighted however health claims linked to these components will require a systematic literature review done to assess the strength of the evidence.

Other high-level recommendations from section summaries that are in addition to those outlined above

- Research overseas markets to identify government investment in public health initiatives addressing malnutrition e.g. school lunch programs, to assess opportunities for the provision of nutrient rich meat blends, or nutrient rich meat-based snacks.
- Undertake a comprehensive nutritional analysis of offal, across type of animal and type of offal to assess as ingredients for nutrient rich fresh meat blends.
- Commission research into the effects of iron-fortified cereals compared to red meat on infant gut health. Pending results, use to support a campaign on red meat and infant growth and development linked to the importance of good nutrition in the first 1,000 days of life.
- Develop and promote 100% pure red meat baby food products for infants in the 6–12 month age bracket.
- Begin to shift communication focus to personalised messages rather than a "one size fits all" approach to nutrition and dietary advice. Seek ways to communicate to consumers that products are "designed for me".
- Start building a database of red meat components that benefit certain genotypes and microbiome types to prepare for the future.
- Invest in the development of systematic reviews to substantiate general level health claims for industry use that are linked to bioactives and nutrients in meat. For example, collagen and skin health, creatine and muscle strength, protein and satiety, L-carnitine and weight management.

Conclusions and recommendations

Red meat is a nutrient rich food that lends itself to further innovation, both through marketing lead communication initiatives and product development. This report has provided an overview of global macro-trends that will influence the future of food, covered key health and nutrition issues, provided a snapshot of the nutritional profile of beef, lamb, goat and offal, given details on the benefits of some of the key nutrients found in red meat, and outlined some of the key global health trends of relevance to consumers, along with areas where consumer behaviour is changing as it relates to product formats and delivery.

As a result of the research undertaken, three priority areas for innovation are recommended, along with three second tier opportunities. These are outlined and expanded upon in Section 3.

Acting on these opportunities will assist the red meat industry take advantage of the growing interest in health and wellness globally and to be well positioned to benefit from this expanding $1.8 trillion market.

Glossary

Abbreviations and definitions used throughout this report.

ABS – Australian Bureau of Statistics

AI – Adequate Intake

APOE4 gene – a gene associated with increased risk of Alzheimer's Disease

BMI – Body Mass Index (a measure of weight status)

Bioavailability – the extent to which a nutrient is absorbed by the body

CAGR – compound annual growth rate

Choline – an essential nutrient that is similar to a B vitamin.

Chondroitin sulphate – a natural compound found in the cartilage of joints

Coenzyme Q10 – a vitamin-like substance involved in energy production cycle that also has antioxidant and anti-inflammatory properties

Creatine – a substance found in muscle cells that helps with energy production

DHA – docosahexaenoic acid (a type of omega-3 fatty acid)

DI – Daily Intake

EPA – eicosapentaenoic acid (a type of omega-3 fatty acid)

FAO – Food & Agricultural Organisation

FTO gene – a gene associated with increased risk of overweight and obesity

Functional foods – food that provide health effects over and above the delivery of nutrients

FUT2 gene – a gene associated with immunity

L-carnitine – an amino acid that contributes to energy production and fatty acid metabolism

Microbiome – the community of microorganisms that live in the human gut

MTHFR gene – a gene that provides instructions for producing folate

NHMRC – National Health & Medical Research Council

Nootropics – substances in food that enhance cognitive functioning

OECD – Organisation for Economic Co-operation and Development

RDI – Recommended Dietary Intake

ROS – reactive oxygen species

Sarcopenia – aging-related progressive loss of skeletal muscle mass and strength

SDT – Suggested Daily Target

UPF – ultra processed food

WHO – World Health Organization

References

1   World Health Organisation (2024). Obesity and Overweight. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight (accessed 2 Nov 2024).

2   Obesity Evidence Hub (2023). Projections of global obesity among adults, up to 2035. https://www.obesityevidencehub.org.au/collections/trends/projections#:~:text=Projections of global obesity among,by the World Obesity Federation (accessed 2 Nov 2024).

3   Australian Goverment Australian Institute of Health and Welfare (2024). Overweight and obesity, Summary. https://www.aihw.gov.au/reports/overweight-obesity/overweight-and-obesity/contents/overweight-and-obesity (accessed 7 Nov 2024).

4   The Daily Telegraph (2019). More overweight Australians are also malnourished. https://www.dailytelegraph.com.au/lifestyle/health/more-overweight-australians-are-also-malnourished/news-story/ec4426e20d491cb728fb0b327e853eac (accessed 7 Nov 2024).

5   World Obesity Federation (2024). World Obesity Atlas 2023. https://www.worldobesity.org/resources/resource-library/world-obesity-atlas-2023 (accessed 7 Nov 2024).

6   Obesity Evidence Hub (2023). Projections of global obesity among children and adolescents, up to 2035. https://www.obesityevidencehub.org.au/collections/trends/projections#:~:text=Projections of obesity and its,projected increase is 2.6%25 annually (accessed 2 Nov 2024).

7   World Obesity Federation (2022). The Economic Impact of Overweight & Obesity in 2020 and 2060 2nd Edition with Estimates for 161 Countries. https://data.worldobesity.org/publications/WOF-Economic-Impacts-2-V2.pdf.

8   Word Obesity Federation (2024). Economic Impact of Overweight and Obesity: Australia. https://data.worldobesity.org/economic-impact-new/countries/#AU (accessed 1 Nov 2024).

9   World Health Organization (2024). Implementation roadmap 2023–2030 for the Global action plan for the prevention and control of NCDs 2013–2030. https://www.who.int/teams/noncommunicable-diseases/governance/roadmap.

10 Australian Government Department of Health and Aged Care (2022). National Obesity Strategy 2022-2032. https://www.health.gov.au/resources/publications/national-obesity-strategy-2022-2032?language=en.

11 Australian Government Department of Health and Aged Care National Preventive Health Strategy 2021–2030. https://www.health.gov.au/resources/publications/national-preventive-health-strategy-2021-2030?language=en.

12 GBD 2017 Diet Collaborators (2019). Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet* **393**, 1958–1972. PMID: 30954305.

13 Australian Government Australian Institute of Health and Welfare (2024). Diet. https://www.aihw.gov.au/reports/food-nutrition/diet (accessed 1 Nov 2024).

14 World Health Organization (2023). Colorectal cancer key facts. https://www.who.int/news-room/fact-sheets/detail/colorectal-cancer.

15 Partyline (2018). Major review of Aboriginal and Torres Strait Islander nutrition. https://www.ruralhealth.org.au/partyline/article/major-review-aboriginal-and-torres-strait-islander-nutrition.

16 World Health Organization (2023). Noncommunicable diseases. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases.

17 International Diabetes Foundation (2022). IDF Diabetes Atlas 2021. https://diabetesatlas.org/atlas/tenth-edition/.

18 Clinton SK, Giovannucci EL, Hursting SD (2020). The World Cancer Research Fund/American Institute for Cancer Research Third Expert Report on Diet, Nutrition, Physical Activity, and Cancer: Impact and Future Directions. J Nutr **150**, 663–671. PMID: 31758189.

19 World Health Organization (2021). Global status report on the public health response to dementia. https://www.who.int/publications/i/item/9789240033245.

20 Australian Government Australian Institute of Health and Welfare (2020). Australia's health 2020: data insights. https://www.aihw.gov.au/reports/australias-health/australias-health-2020-data-insights/summary.

21 Heart Foundation of Australia (2024). Statistics and information on cardiovascular disease in Australia. https://www.heartfoundation.org.au/your-heart/evidence-and-statistics/key-stats-cardiovascular-disease (accessed 1 Nov 2024).

22 Australian Government Australian Institute of Health and Welfare (2024). Dementia in Australia. https://www.aihw.gov.au/reports/dementia/dementia-in-aus/contents/summary.

23 Kennedy J, Alexander P, Taillie LS, Jaacks LM (2024). Estimated effects of reductions in processed meat consumption and unprocessed red meat consumption on occurrences of type 2 diabetes, cardiovascular disease, colorectal cancer, and mortality in the USA: a microsimulation study. Lancet Planet Health **8**, e441–e451. PMID: 38969472.

24 Australian Government Health Institute of Health and Welfare (2023). Health conditions, disability & deaths. https://www.aihw.gov.au/reports-data/health-conditions-disability-deaths.

25 World Health Organization (2024). Malnutrition. https://www.who.int/health-topics/malnutrition (accessed 1 Nov 2024).

26 Prentice AM (2023). The Triple Burden of Malnutrition in the Era of Globalization. In: Szur R, Miller S (eds). Nestle Nutr Inst Workshop Series. Routledge, pp 51–61.

27 World Food Programme (2024). WFP at a Glance. https://www.wfp.org/stories/wfp-glance (accessed 1 Nov 2024).

28 Lowe NM (2021). The global challenge of hidden hunger: Perspectives from the field. Proceedings of the Nutrition Society **80**, 283–289. PMID: 33896431.

29 UNICEF (2023). UNICEF-WHO-The World Bank: Joint Child Malnutrition Estimates (JME) — Levels and Trends – 2023 edition. https://data.unicef.org/resources/jme-report-2023/ (accessed 1 Nov 2024).

30 World Health Organization (2024). Micronutrients. https://www.who.int/health-topics/micronutrients#tab=tab_1 (accessed 1 Nov 2024).

31 World Health Organization (2024). Nutrition. https://www.who.int/health-topics/nutrition#tab=tab_1 (accessed 1 Nov 2024).

32 Peng W, Mu Y, Hu Y, Li B, Raman J, Sui Z (2020). Double burden of malnutrition in the asia-pacific region-a systematic review and meta-analysis. J Epidemiol Glob Health **10**, 16–27. PMID: 32175706.

33 Brann M, Long W (2024). Indonesia's free school lunch and milk policy a 'significant' opportunity for Australian farmers. Australian Broadcasting Corporaton News.

34 UNICEF (2024). At least 77 million children and adolescents have some form of malnutrition in the Middle East and North Africa. https://www.unicef.org/mena/press-releases/least-77-million-children-and-adolescents-have-some-form-malnutrition-middle-east (accessed 1 Nov 2024).

35 Food Bank (2023). Foodbank Hunger Report 2023. https://reports.foodbank.org.au/foodbank-hunger-report-2023/ (accessed 1 Nov 2024).

36 Australian Bureau of Statistics (2014). Australian Health Survey: Nutrition First Results – Foods and Nutrients. https://www.abs.gov.au/statistics/health/health-conditions-and-risks/australian-health-survey-nutrition-first-results-foods-and-nutrients/latest-release (accessed 21 Oct 2024).

37 Starck CS, Cassettari T, Beckett E, Marshall S, Fayet-Moore F (2024). Priority nutrients to address malnutrition and diet-related diseases in Australia and New Zealand. Front Nutr **11**, PMID: 38544756.

38 The Sydney Morning Herald (2016). Eyesight experts issue warning on diet which can lead to blindness. https://www.smh.com.au/healthcare/eyesight-experts-issue-warning-on-diet-which-can-lead-to-blindness-20161012-gs0twl.html.

39 Antonucci R, Locci C, Clemente MG, Chicconi E, Antonucci L (2018). Vitamin D deficiency in childhood: Old lessons and current challenges. *Journal of Pediatric Endocrinology and Metabolism* **31**, 247–260. PMID: 29397388.

40 Pasricha SRS, Flecknoe-Brown SC, Allen KJ, Gibson PR, McMahon LP, Olynyk JK et al. (2010). Diagnosis and management of iron deficiency anaemia: A clinical update. *Medical Journal of Australia* **193**, 525–532. PMID: 21034387.

41 Meat & Livestock Australia (2022). Nutritional benefits of Australian red meat. https://www.mlahealthymeals.com.au/globalassets/mla-healthy-meals/3.research/reports/mla_nutritional-benefits-report_final.dec22.pdf.

42 Food Standards Australia New Zealand Australian Food Composition Database – Release 2.0 F000678: Beef, mince, regular fat, raw. https://afcd.foodstandards.gov.au/fooddetails.aspx?PFKID=F000678 (accessed 1 Nov 2024).

43 Food Standards Australia New Zealand Australian Food Composition Database – Release 2.0 F005049: Lamb, mince, raw. https://afcd.foodstandards.gov.au/fooddetails.aspx?PFKID=F005049 (accessed 1 Nov 2024).

44 Food Standards Australia New Zealand Australian Food Composition Database – Release 2.0 F004243: Goat, meat, all cuts, untrimmed, raw. https://afcd.foodstandards.gov.au/fooddetails.aspx?PFKID=F004243.

45 Australian Government National Health and Medical Research Council. Manatu Hauora Ministry of Health. Eatforhealth.gov.au (2021). Nutrient Reference Values. https://www.eatforhealth.gov.au/nutrient-reference-values (accessed 1 Nov 2024).

46 Grand View Research (2022). Edible Offal Market Size, Share & Trends Analysis Report By Application (Processed, Fresh), By Distribution Channel (Food Service, Retail), By Source (Cattle, Goat), By Region, And Segment Forecasts, 2023–2030. Grand View Research. https://www.grandviewresearch.com/industry-analysis/edible-offal-market-report (accessed 1 Nov 2024).

47 Williams P (2007). Nutritional composition of red meat. Nutrition and Dietetics **64**, 5–7.

48 Perna S, Alalwan TA, Alaali Z, Alnashaba T, Gasparri C, Infantino V et al. (2019). The role of glutamine in the complex interaction between gut microbiota and health: A narrative review. *Int J Mol Sci* **20**, 1–11. PMID: 31652531.

49 Maharaj A, Fischer SM, Dillon KN, Kang Y, Martinez MA, Figueroa A (2022). Effects of L-Citrulline Supplementation on Endothelial Function and Blood Pressure in Hypertensive Postmenopausal Women. *Nutrients* **14**, PMID: 36297080.

50 International Euromonitor (2024). Shifting Nutritional Trends: Protein Products for Australia's Ageing Population. https://www.euromonitor.com/article/shifting-nutritional-trends-protein-products-for-australias-ageing-population (accessed 1 Nov 2024).

51 Commonwealth Scientific Industrial Research Organisation (CSIRO) (2022). National Protein Roadmap. https://www.csiro.au/en/work-with-us/services/consultancy-strategic-advice-services/csiro-futures/agriculture-and-food/australias-protein-roadmap.

52 Piskin E, Cianciosi D, Gulec S, Tomas M, Capanoglu E (2022). Iron Absorption: Factors, Limitations, and Improvement Methods. *ACS Omega* **7**, 20441–20456.

53 Czerwonka M, Tokarz A (2017). Iron in red meat–friend or foe. *Meat Sci* **123**, 157–165. PMID: 27744145.

54 World Health Organization (2015). The global prevalence of anaemia in 2011.

55 Zheng JJ, Mason JB, Rosenberg IH, Wood RJ (1993). Measurement of zinc bioavailability from beef and a ready-to-eat high-fiber breakfast cereal in humans: application of a whole-gut lavage technique. *Am J Clin Nutr* **58**, 902–907.

56 Jalla S, Westcott J, Steirn M, Miller L V., Bell M, Krebs NF (2002). Zinc Absorption and Exchangeable Zinc Pool Sizes in Breast-Fed Infants Fed Meat or Cereal as First Complementary Food. *J Pediatr Gastroenterol Nutr* **34**, 35–41.

57 Lowe NM, Hall AG, Broadley MR, Foley J, Boy E, Bhutta ZA (2024). Preventing and Controlling Zinc Deficiency Across the Life Course: A Call to Action. *Advances in Nutrition* **15**, PMID: 38280724.

58 Gupta S, Brazier AKM, Lowe NM (2020). Zinc deficiency in low- and middle-income countries: prevalence and approaches for mitigation. *Journal of Human Nutrition and Dietetics* **33**, 624–643. PMID: 32627912.

59 Melaku EE, Urgie BM, Tilahun AT, Assefa HK, Abebe AA, Tefera AS (2024). Prevalence of vitamin B 12 deficiency and associated factors among primary school children: North East Ethiopia: multicenter cross-sectional study. *J Health Popul Nutr* **43**, 1–7. PMID: 38867328.

60 Rodriguez D, Lavie CJ, Elagizi A, Milani R V (2022). Update on Omega-3 Polyunsaturated Fatty Acids on Cardiovascular Health. *Nutrients* **14**, 289–300. PMID: 36501174.

61 Abdelrahman MA, Osama H, Saeed H, Madney YM, Harb HS, Abdelrahim MEA (2023). Impact of n-3 polyunsaturated fatty acid intake in pregnancy on maternal health and birth outcomes: systematic review and meta-analysis from randomized controlled trails. *Arch Gynecol Obstet* **307**, 249–262. PMID: 35348829.

62 Welty FK (2023). Omega-3 fatty acids and cognitive function. *Curr Opin Lipidol* **34**, 12–21. PMID: 36637075.

63 Meyer BJ (2016). Australians are not meeting the recommended intakes for omega-3 long chain polyunsaturated fatty acids: Results of an analysis from the 2011–2012 national nutrition and physical activity survey. *Nutrients* **8**, PMID: 26927162.

64 Zhang X, Ritonja JA, Zhou N, Chen BE, Li X (2022). Omega-3 Polyunsaturated Fatty Acids Intake and Blood Pressure: A Dose-Response Meta-Analysis of Randomized Controlled Trials. *J Am Heart Assoc* **11**, PMID: 35647665.

65 Derbyshire E, Obeid R (2020). Choline, Neurological Development and Brain Function: A Systematic Review Focusing on the First 1,000 Days. *Nutrients* **12**, 1–31. PMID: 32531929.

66 Virtanen JK, Tuomainen T-P, Voutilainen S (2020). Dietary intake of choline and phosphatidylcholine and risk of type 2 diabetes in men: The Kuopio Ischaemic Heart Disease Risk Factor Study. *Eur J Nutr* **59**, 3857–3861. PMID: 32198672.

67 Golzarand M, Bahadoran Z, Mirmiran P, Azizi F (2021). Dietary choline and betaine intake and risk of hypertension development: a 7.4-year follow-up. *Food Funct* **12**, 4072–4078. PMID: 33977970.

68 Lee CW, Galvan E, Lee T V., Chen VCW, Bui S, Crouse SF et al. (2023). Low Intake of Choline Is Associated with Diminished Strength and Lean Mass Gains in Older Adults. *J Frailty Aging* **12**, 78–83. PMID: 36629089.

69 Zhou R, Yang M, Yue C, Shi Y, Tan Y, Zha L et al. (2023). Association between Dietary Choline Intake and Cardiovascular Diseases: National Health and Nutrition Examination Survey 2011-2016. *Nutrients* **15**, PMID: 37764819.

70 Yuan J, Liu X, Liu C, Ang AFA, Massaro J, Devine SA et al. (2022). Is dietary choline intake related to dementia and Alzheimer's disease risks? Results from the Framingham Heart Study. *Am J Clin Nutr* **116**, 1201–1207. PMID: 37208066.

71 Obeid R, Karlsson T (2023). Choline – a scoping review for Nordic Nutrition Recommendations 2023. *Food Nutr Res* **67**, 1–11. PMID: 38187796.

72 Probst Y, Guan V, Neale E (2019). Development of a Choline Database to Estimate Australian Population Intakes. *Nutrients* **11**, 1–13. PMID: 31018620.

73 Agarwal S, Fulgoni VL (2022). Contribution of beef to key nutrient intakes in American adults: an updated analysis with NHANES 2011–2018. *Nutr Res* **105**, 105–112. PMID: 35914468.

74 Sui Z, Raubenheimer D, Rangan A (2017). Consumption patterns of meat, poultry, and fish after disaggregation of mixed dishes: Secondary analysis of the Australian National Nutrition and Physical Activity Survey 2011–12. *BMC Nutr* **3**, 1–12.

75 Sui Z, Raubenheimer D, Rangan A (2017). Consumption patterns of meat, poultry, and fish after disaggregation of mixed dishes: Secondary analysis of the Australian National Nutrition and Physical Activity Survey 2011–12. *BMC Nutr* **3**, 1–12. PMID: 32153832.

76 Meat & Livestock Australia (2024). Community sentiment research Australian perceptions about the red meat industry. https://www.mla.com.au/marketing-beef-lamb-and-goat/consumer-sentiment-research/.

77 Australian Bureau of Statistics (2024). Apparent Consumption of Selected Foodstuffs, Australia. https://www.abs.gov.au/statistics/health/health-conditions-and-risks/apparent-consumption-selected-foodstuffs-australia/latest-release.

78 Australian Bureau of Statistics (2023). Population Projections, Australia. https://www.abs.gov.au/statistics/people/population/population-projections-australia/latest-release.

79 Meat & Livestock Australia (2023). State of the industry Report The Australian red meat and livestock industry 2223. https://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/soti-report/mla-state-of-the-industry-report-2223-web.pdf (accessed 14 Nov 2024).

80 Our World in Data Per capita meat consumption by type, 2021. https://ourworldindata.org/grapher/per-capita-meat-type.

81 Meat & Livestock Australia (2024). State of Industry Report. Exploring the economic impact and landscape of the Australian red meat and livestock industry using comprehensive data from 2023. https://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/soti-report/mla-state-of-the-industry-report-2324-web.pdf.

82 Organisation for Economic Co-operation and Development (OECD) and the Food and Agricultural Organization (FAO) of the United Nations (2023). 'Meat' in OECD-FAO Agricultural Outlook 2023-2032. https://www.oecd-ilibrary.org/agriculture-and-food/oecd-fao-agricultural-outlook-2023-2032_08801ab7-en.

83 Food and Agriculture Organization of the United Nations (2018). The future of food and agriculture Alternative pathways to 2050 Supplementary material. https://openknowledge.fao.org/server/api/core/bitstreams/1c58eb36-7684-4032-946d-f014fd777782/content.

84 Schwarzenberg SJ, Georgieff MK, COMMITTEE ON NUTRITION (2018). Advocacy for Improving Nutrition in the First 1,000 Days to Support Childhood Development and Adult Health. *Pediatrics* **141**, PMID: 29358479.

85 Alves JGB, Alves LV (2024). Early-life nutrition and adult-life outcomes. *J Pediatr (Rio J)* **100 Suppl**, S4–S9. PMID: 37813343.

86 Food and Agriculture Organization of the United Nations (2023). Contribution of terrestrial animal source food to healthy diets for improved nutrition and health outcomes – An evidence and policy overview on the state of knowledge and gaps. https://openknowledge.fao.org/items/dab2e56d-1dc4-47ab-848f-c324188a66c8.

87 Australian Government National Health and Medical Research Council (2024). Infant Feeding Guidelines. https://www.nhmrc.gov.au/health-advice/public-health/nutrition/infant-feeding-guidelines.

88 World Health Organization (2023). WHO Guideline for complementary feeding of infants and young children 6–23 months of age. https://www.who.int/publications/i/item/9789240081864.

89 Cai C, Harding S, Friel J (2016). Breast Milk Iron Concentrations may be Lower than Previously Reported: Implications for Exclusively Breastfed Infants. Matern Pediatr Nutr **2**.

90 Friel J, Qasem W, Cai C (2018). Iron and the Breastfed Infant. *Antioxidants (Basel)* **7**, 2–9. PMID: 29642400.

91 Friel JK, Isaak CA, Hanning R, Miller A (2009). Complementary Food Consumption of Canadian Infants. *Open Nutr J* **3**, 11–16.

92 Davidsson L, Kastenmayer P, Szajewska H, Hurrell RF, Barclay D (2000). Iron bioavailability in infants from an infant cereal fortified with ferric pyrophosphate or ferrous fumarate. *Am J Clin Nutr* **71**, 1597–602. PMID: 10837304.

93 Halliwell B (1994). Free radicals and antioxidants: a personal view. *Nutr Rev* **52**, 253–65. PMID: 7970288.

94 Grummer-Strawn LM, Scanlon KS, Fein SB (2008). Infant feeding and feeding transitions during the first year of life. *Pediatrics* **122 Suppl**, S36-42. PMID: 18829829.

95 Friel JK, Hanning RM, Isaak CA, Prowse D, Miller AC (2010). Canadian infants' nutrient intakes from complementary foods during the first year of life. *BMC Pediatr* **10**, 43. PMID: 20565759.

96 Wang M (2016). Iron Deficiency and Other Types of Anemia in Infants and Children. *Am Fam Physician* **93**, 270–8. PMID: 26926814.

97 Krebs NF, Westcott JE, Butler N, Robinson C, Bell M, Hambidge KM (2006). Meat as a first complementary food for breastfed infants: feasibility and impact on zinc intake and status. *J Pediatr Gastroenterol Nutr* **42**, 207–14. PMID: 16456417.

98 Wilk VC, McGuire MK, Roe AJ (2022). Early Life Beef Consumption Patterns Are Related to Cognitive Outcomes at 1-5 Years of Age: An Exploratory Study. *Nutrients* **14**, 1–14. PMID: 36364760.

99 Cox KA, Parkin PC, Anderson LN, Chen Y, Birken CS, Maguire JL et al. (2016). Association Between Meat and Meat-Alternative Consumption and Iron Stores in Early Childhood. *Acad Pediatr* **16**, 783–791. PMID: 26804490.

100 Fayet-Moore F, McConnell A, Tuck K, Petocz P, Cassettari T, Rahimi-Ardabili H et al. (2022). Patterns of discretionary food intake among Australian children and their association with socio-demographic, lifestyle, and adiposity measures. *Nutr Diet* **79**, 623–635. PMID: 35708110.

101 Solomons N (2001). Dietary sources of zinc and factors affecting its bioavailability. *Food Nutr Bull* **22**, 138–154.

102 NSW Government Illawarra Shoalhaven Local Health District Childcare menu planning. https://www.islhd.health.nsw.gov.au/sites/default/files/Health_Promotion/MunchMove/Cooks-Resource_Nov_2020S.pdf.

103 Black Dog Institiue Addressing Australia's Mental Health Crisis: Time for Bold Reform. https://www.blackdoginstitute.org.au/news/addressing-australias-mental-health-crisis-time-for-bold-reform/.

104 Australian Government Australian Institute of Health and Welfare (2024). Deaths in Australia. https://www.aihw.gov.au/reports/life-expectancy-deaths/deaths-in-australia/contents/leading-causes-of-death (accessed 23 Oct 2024).

105 National Eating Disorders Collaboration Eating Disorders in Australia. https://nedc.com.au/eating-disorders/eating-disorders-explained/eating-disorders-in-australia.

106 Young LM, Moylan S, John T, Turner M, Opie R, Hockey M et al. (2022). Evaluating telehealth lifestyle therapy versus telehealth psychotherapy for reducing depression in adults with COVID-19 related distress: the curbing anxiety and depression using lifestyle medicine (CALM) randomised non-inferiority trial protocol. *BMC Psychiatry* **22**, 219. PMID: 35346115.

107 Bujtor M, Turner AI, Torres SJ, Esteban-Gonzalo L, Pariante CM, Borsini A (2021). Associations of Dietary Intake on Biological Markers of Inflammation in Children and Adolescents: A Systematic Review. *Nutrients* **13**, 1–29. PMID: 33503979.

108 World Health Organization (2014). Global nutrition targets 2025: anaemia policy brief. https://www.who.int/publications/i/item/WHO-NMH-NHD-14.4.

109 Global Nutrition Report (2024). Country Nutrition Profiles Australia. https://globalnutritionreport.org/resources/nutrition-profiles/oceania/australia-and-new-zealand/australia/.

110 Zhang J, Li Q, Song Y, Fang L, Huang L, Sun Y (2022). Nutritional factors for anemia in pregnancy: A systematic review with meta-analysis. *Front Public Health* **10**, 1041136. PMID: 36311562.

111 Mishra GD, Schoenaker DAJM, Mihrshahi S, Dobson AJ (2015). How do women's diets compare with the new Australian dietary guidelines? *Public Health Nutr* **18**, 218–25. PMID: 24589225.

112 Caut C, Leach M, Steel A (2020). Dietary guideline adherence during preconception and pregnancy: A systematic review. *Matern Child Nutr* **16**, e12916. PMID: 31793249.

113 Australian Government Australian Institute of Health and Welfare (2024). Older Australians Summary. https://www.aihw.gov.au/reports/older-people/older-australians/contents/summary.

114 World Health Organization (2023). Dementia. https://www.who.int/news-room/fact-sheets/detail/dementia.

115 Dementia Australia (2024). Dementia facts and figures. https://www.dementia.org.au/about-dementia/dementia-facts-and-figures (accessed 1 Nov 2024).

116 Paul TL, Fleming SA (2023). Dietary consumption of beef and red meat: a scoping review and evidence map on cognitive outcomes across the lifespan. *Public Health Nutr* **26**, 2912–2926. PMID: 37800340.

117 Formica MB, Gianoudis J, Nowson CA, O'Connell SL, Milte C, Ellis KA et al. (2020). Effect of lean red meat combined with a multicomponent exercise program on muscle and cognitive function in older adults: a 6-month randomized controlled trial. *Am J Clin Nutr* **112**, 113–128. PMID: 32469398.

118 He W, Connolly ED, Cross HR, Wu G (2024). Dietary protein and amino acid intakes for mitigating sarcopenia in humans. *Crit Rev Food Sci Nutr* **112**, 1–24. PMID: 38803274.

119 Rondanelli M, Perna S, Faliva MA, Peroni G, Infantino V, Pozzi R (2015). Novel Insights On Intake Of Meat And Prevention Of Sarcopenia: All Reasons For An Adequate Consumption. *Nutr Hosp* **32**, 2136–43. PMID: 26545670.

120 Lynch GS, Koopman R (2018). Dietary meat and protection against sarcopenia. *Meat Sci* **144**, 180–185. PMID: 29941158.

121 Hawley AL, Liang X, Børsheim E, Wolfe RR, Salisbury L, Hendy E et al. (2022). The potential role of beef and nutrients found in beef on outcomes of wellbeing in healthy adults 50 years of age and older: A systematic review of randomized controlled trials. *Meat Sci* **189**, 108830. PMID: 35483315.

122 Partridge SR, Gibson AA, Roy R, Malloy JA, Raeside R, Jia SS et al. (2020). Junk Food on Demand: A Cross-Sectional Analysis of the Nutritional Quality of Popular Online Food Delivery Outlets in Australia and New Zealand. *Nutrients* **12**, PMID: 33053705.

123 United Nations Department of Economic and Social Affairs (2024). 68% of the world population projected to live in urban areas by 2050, says UN. https://www.un.org/uk/desa/68-world-population-projected-live-urban-areas-2050-says-un.

124 Colozza D, Wang Y-C, Avendano M (2023). Does urbanisation lead to unhealthy diets? Longitudinal evidence from Indonesia. *Health Place* **83**, 103091. PMID: 37490794.

125 Food and Agriculture Organization of the United Nations (2024). How to feed the world in 2050. https://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf.

126 Statista (2024). Australia: Urbanization from 1960 to 2023. https://www.statista.com/statistics/260498/degree-of-urbanization-in-australia/.

127 World Health Organization (2024). Ageing and health. https://www.who.int/news-room/fact-sheets/detail/ageing-and-health.

128 Parliament of Australia Aged care. https://www.aph.gov.au/About_Parliament/Parliamentary_departments/Parliamentary_Library/Budget/reviews/2024-25/Aged_care?CalendarWidgetTarget=12-06-2024&tab=tab2a#:~:text=Australia's ageing population presents a,91).

129 Mintel 2025 Global Consumer Trends. https://www.mintel.com/insights/consumer-research/global-consumer-trends/.

130 The Power to Persuade (2024). The Rise of Online Food Delivery Services: Global trends and their disruptive impact on our food environments. https://www.powertopersuade.org.au/blog/the-rise-of-online-food-delivery-services-global-trends-and-their-disruptive-impact-on-our-food-environments/19/7/2024 (accessed 13 Nov 2024).

131 Partridge SR, Gibson AA, Roy R, Malloy JA, Raeside R, Jia SS et al. (2020). Junk food on demand: A cross-sectional analysis of the nutritional quality of popular online food delivery outlets in Australia and New Zealand. *Nutrients* **12**, 1–16. PMID: 33053705.

132 Innova Market Insights (2024). Consumer Trends: Global Convenience Eating. https://www.innovamarketinsights.com/trends/consumer-trends-global-convenience-eating/.

133 Innova Market Insights (2024). Consumer Snacking Trends: Exploring Global & Emerging Opportunities. https://www.innovamarketinsights.com/trends/consumer-snacking-trends/.

134 Innova Market Insights (2024). Global Meat Snacks Trends. https://www.innovamarketinsights.com/trends/global-meat-snacks-trends/ (accessed 13 Nov 2024).

135 International Euromonitor (2024). Five Key Snack Trends to Track in 2024–2025. https://www.euromonitor.com/article/five-key-snack-trends-to-track-in-2024-2025.

136 Globalsources (2024). Health and Nutrition Trends. https://www.globalsources.com/knowledge/snack-food-industry-trends/#1.

137 Four Thirty Healthy Snacking. https://fourthirty.in/blogs/news/healthy-snacking-unveiled-discover-2024s-healthy-snack-trends.

138 Fifth quadrant (2024). Top food trends 2024: what is australia cooking? https://www.fifthquadrant.com.au/top-food-trends-2024-au-cooking.

139 Global Wellness Institute (2023). The 2023 Global Wellness Economy Monitor 2023. https://globalwellnessinstitute.org/industry-research/2023-global-wellness-economy-monitor/.

140 Global Wellness Institute (2024). The Global Wellness Economy Reaches a New Peak of $6.3 Trillion––And Is Forecast to Hit $9 Trillion by 2028. https://globalwellnessinstitute.org/press-room/press-releases/the-global-wellness-economy-reaches-a-new-peak-of-6-3-trillion-and-is-forecast-to-hit-9-trillion-by-2028/?utm_campaign=Wellness Economy Monitor&utm_medium=email&_hsenc=p2ANqtz-_Z2TjCkFezLEW1VvD.

141 McKinsey & Company (2024). State of the Consumer 2024: What's now and what's next. https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/state-of-consumer.

142 Global Wellness Institute The Global Wellness Economy Reaches a New Peak of $6.3 Trillion––And Is Forecast to Hit $9 Trillion by 2028. https://globalwellnessinstitute.org/press-room/press-releases/the-global-wellness-economy-reaches-a-new-peak-of-6-3-trillion-and-is-forecast-to-hit-9-trillion-by-2028/?utm_campaign=Wellness Economy Monitor&utm_medium=email&_hsenc=p2ANqtz-_Z2TjCkFezLEW1VvD.

143 Ordovas JM, Ferguson LR, Tai ES, Mathers JC (2018). Personalised nutrition and health. *BMJ* **361**, bmj.k2173. PMID: 29898881.

144 Commonwealth Scientific Industrial Research Organisation (CSIRO) Australian Food and agribusiness Personalised nutrition. https://research.csiro.au/foodag/health-and-wellbeing/personalised-nutrition/.

145   McKinsey & Company (2024). The trends defining the $1.8 trillion global wellness market in 2024. https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/the-trends-defining-the-1-point-8-trillion-dollar-global-wellness-market-in-2024.

146   Loos RJF, Yeo GSH (2014). The bigger picture of FTO: the first GWAS-identified obesity gene. *Nat Rev Endocrinol* **10**, 51–61. PMID: 24247219.

147   Merritt DC, Jamnik J, El-Sohemy A (2018). FTO genotype, dietary protein intake, and body weight in a multiethnic population of young adults: a cross-sectional study. *Genes Nutr* **13**, 4. PMID: 29484031.

148   Biesiekierski JR, Jalanka J, Staudacher HM (2019). Can Gut Microbiota Composition Predict Response to Dietary Treatments? *Nutrients* **11**, 1–15. PMID: 31121812.

149   Healbe GoBe3. https://healbe.com/.

150   The Verge This tiny chip is being used to develop a tooth-mounted sensor that can read your spit. https://www.theverge.com/2023/3/14/23638315/silicon-labs-lura-health-xg27-wearable-medical-device-chip.

151   Mintel 2025 Global Food and Drink Trends. https://www.mintel.com/insights/food-and-drink/global-food-and-drink-trends/.

152   Mintel (2024). 2025 Global Food and Drink Trends. https://www.mintel.com/insights/food-and-drink/global-food-and-drink-trends/.

153   Sienski G, Narayan P, Bonner JM, Kory N, Boland S, Arczewska AA et al. (2021). APOE4 disrupts intracellular lipid homeostasis in human iPSC-derived glia. *Sci Transl Med* **13**, PMID: 33658354.

154   Keum M, Lee BC, Choe YM, Suh G-H, Kim SG, Kim HS et al. (2024). Protein intake and episodic memory: the moderating role of the apolipoprotein E ε4 status. *Alzheimers Res Ther* **16**, 181. PMID: 39135146.

155   Al-Batayneh KM, Zoubi MS Al, Shehab M, Al-Trad B, Bodoor K, Khateeb W Al et al. (2018). Association between MTHFR 677C>T Polymorphism and Vitamin B12 Deficiency: A Case-control Study. *J Med Biochem* **37**, 141–147. PMID: 30581350.

156   Fi Global Insights (2024). The gut health trend is here to stay – but how will it evolve? https://insights.figlobal.com/diet-health/the-gut-health-trend-is-here-to-stay-but-how-will-it-evolve- (accessed 13 Nov 2024).

157   Mintel (2024). The future foundation of a healthy gut. https://www.mintel.com/insights/food-and-drink/the-future-foundation-of-a-healthy-gut/.

158   Wang Y, Uffelman CN, Bergia RE, Clark CM, Reed JB, Cross T-WL et al. (2023). Meat Consumption and Gut Microbiota: a Scoping Review of Literature and Systematic Review of Randomized Controlled Trials in Adults. *Adv Nutr* **14**, 215–237. PMID: 36822879.

159   Lee C, Lee J, Eor JY, Kwak M-J, Huh CS, Kim Y (2023). Effect of Consumption of Animal Products on the Gut Microbiome Composition and Gut Health. *Food Sci Anim Resour* **43**, 723–750. PMID: 37701742.

160   Gojda J, Cahova M (2021). Gut Microbiota as the Link between Elevated BCAA Serum Levels and Insulin Resistance. *Biomolecules* **11**, 1–16. PMID: 23452586.

161   Krebs NF, Sherlock LG, Westcott J, Culbertson D, Hambidge KM, Feazel LM et al. (2013). Effects of different complementary feeding regimens on iron status and enteric microbiota in breastfed infants. *J Pediatr* **163**, 416–23. PMID: 23452586.

162   World Cancer Research Fund International (2024). Limit red and processed meat. https://www.wcrf.org/diet-activity-and-cancer/cancer-prevention-recommendations/limit-red-and-processed-meat/.

163   Munekata PES, Pateiro M, Tomasevic I, Domínguez R, da Silva Barretto AC, Santos EM et al. (2022). Functional fermented meat products with probiotics-A review. *J Appl Microbiol* **133**, 91–103. PMID: 34689391.

164   International Foundation of Integrated Care (2024). 2024 IFIC Food & Health SURVEY. https://foodinsight.org/wp-content/uploads/2024/06/2024-IFIC-Food-Health-Survey.pdf (accessed 13 Nov 2024).

165   Mintel (2024). Promoting 'well-ageing' vs 'anti-ageing' for consumers aged 55 and over. https://www.mintel.com/insights/consumer-research/promoting-well-ageing-over-anti-ageing-for-senior-consumers/ (accessed 13 Nov 2024).

166   Polaris Market Research (2022). Skin Health Foods Market Share, Size, Trends, Industry Analysis Report, By Indication (Anti-Aging, Skin Conditions, Anti-Allergy); By Region; Segment Forecast, 2022–2030. https://www.polarismarketresearch.com/industry-analysis/skin-health-foods-market.

167   Euromonitor International (2024). What Are the Top Consumer Trends in 2024? https://www.euromonitor.com/article/what-are-the-top-consumer-trends-in-2024.

168   Arthritis Australia (2024). Millennials Face A Painful & Stiff Future || New Report Reveals Generations Hit Hardest with Arthritis. https://arthritisaustralia.com.au/arthritis-projections-2040/#:~:text=Main Projections from the Report%3A&text=In 2025%2C 4.1 million Australians,and over 3.2 million women.

169   Brito R, Costa D, Dias C, Cruz P, Barros P (2023). Chondroitin Sulfate Supplements for Osteoarthritis: A Critical Review. *Cureus* **15**, e40192. PMID: 37431333.

170   Simental-Mendía M, Sánchez-García A, Vilchez-Cavazos F, Acosta-Olivo CA, Peña-Martínez VM, Simental-Mendía LE (2018). Effect of glucosamine and chondroitin sulfate in symptomatic knee osteoarthritis: a systematic review and meta-analysis of randomized placebo-controlled trials. *Rheumatol Int* **38**, 1413–1428. PMID: 29947998.

171   Arthritis Australia (2024). Glucosamine and chondroitin. https://arthritisaustralia.com.au/managing-arthritis/living-with-arthritis/complementary-treatments-and-therapies/glucosamine-and-chondroitin/.

172   Grand View Research (2024). Bone And Joint Health Supplements Market Size, Share & Trends Analysis Report By Product (Vitamins, Mineral, Collagen, Omega-3, Glucosamine), By Formulation, By Consumer Group, By Sales Channel, By Region, And Segment Forecasts, 2024–2030. https://www.grandviewresearch.com/industry-analysis/bone-joint-health-supplements-market-report (accessed 13 Nov 2024).

173   LesMills Asia Pacific (2024). Landmark report lifts the lid on Gen Z fitness. https://www.lesmills.com.au/news/clubs/2023/07/landmark-report-lifts-the-lid-on-gen-z-fitness#:~:text=Thirty per cent of Gen,cent%2C depending on the market.

174   Australian Bureau of Statistics (2023). Physical activity. https://www.abs.gov.au/statistics/health/health-conditions-and-risks/physical-activity/latest-release.

175   Antonio J, Candow DG, Forbes SC, Gualano B, Jagim AR, Kreider RB et al. (2021). Common questions and misconceptions about creatine supplementation: what does the scientific evidence really show? *J Int Soc Sports Nutr* **18**, 13. PMID: 33557850.

176   Bird SP (2003). Creatine supplementation and exercise performance: a brief review. *J Sports Sci Med* **2**, 123–32. PMID: 24688272.

177   Mielgo-Ayuso J, Pietrantonio L, Viribay A, Calleja-González J, González-Bernal J, Fernández-Lázaro D (2021). Effect of Acute and Chronic Oral l-Carnitine Supplementation on Exercise Performance Based on the Exercise Intensity: A Systematic Review. *Nutrients* **13**, PMID: 34959912.

178   Valenzuela PL, Mata F, Morales JS, Castillo-García A, Lucia A (2019). Does beef protein supplementation improve body composition and exercise performance? A systematic review and meta-analysis of randomized controlled trials. *Nutrients* **11**, PMID: 31242624.

179   Grand View Research (2024). Sports Nutrition Market Size, Share & Trends Analysis Report By Product Type (Sports Supplements, Sports Drinks), By Formulation, By Consumer Group, By Sales Channel, By Region, And Segment Forecasts, 2024–2030. https://www.grandviewresearch.com/industry-analysis/sports-nutrition-market (accessed 13 Nov 2024).

180   FMCG Gurus (2023). Heart Health: Consumer Attitudes and Product Formats. https://fmcggurus.com/blog/heart-health-consumer-attitudes-and-product-formats/ (accessed 13 Nov 2024).

181   Saini R (2011). Coenzyme Q10: The essential nutrient. *J Pharm Bioallied Sci* **3**, 466–7. PMID: 21966175.

182   Ayers J, Cook J, Koenig RA, Sisson EM, Dixon DL (2018). Recent Developments in the Role of Coenzyme Q10 for Coronary Heart Disease: a Systematic Review. *Curr Atheroscler Rep* **20**, 29. PMID: 29766349.

183   Santulli G, Kansakar U, Varzideh F, Mone P, Jankauskas SS, Lombardi A (2023). Functional Role of Taurine in Aging and Cardiovascular Health: An Updated Overview. *Nutrients* **15**, PMID: 37836520.

184   Song X, Qu H, Yang Z, Rong J, Cai W, Zhou H (2017). Efficacy and Safety of L-Carnitine Treatment for Chronic Heart Failure: A Meta-Analysis of Randomized Controlled Trials. *Biomed Res Int* **2017**, 6274854. PMID: 28497060.

185   Grand View Research (2024). Cardiovascular Health Supplements Market Size, Share & Trends Analysis Report By Type (Natural Supplements, Synthetic Supplements), By Form (Liquid, Tablet), By Ingredient, By Distribution Channel, By Region, And Segment Forecasts, 2023–2030. https://www.grandviewresearch.com/industry-analysis/cardiovascular-health-supplements-market-report (accessed 13 Nov 2024).

186   CNN (2024). 1 in 8 adults in the US has taken Ozempic or another GLP-1 drug, KFF survey finds. https://edition.cnn.com/2024/05/10/health/ozempic-glp-1-survey-kff/index.html.

187   Talenezhad N, Mohammadi M, Ramezani-Jolfaie N, Mozaffari-Khosravi H, Salehi-Abargouei A (2020). Effects of l-carnitine supplementation on weight loss and body composition: A systematic review and meta-analysis of 37 randomized controlled clinical trials with dose-response analysis. *Clin Nutr ESPEN* **37**, 9–23. PMID: 32359762.

188   Pooyandjoo M, Nouhi M, Shab-Bidar S, Djafarian K, Olyaeemanesh A (2016). The effect of (L-)carnitine on weight loss in adults: a systematic review and meta-analysis of randomized controlled trials. *Obes Rev* **17**, 970–6. PMID: 27335245.

189   Rebouche CJ (2004). Kinetics, pharmacokinetics, and regulation of L-carnitine and acetyl-L-carnitine metabolism. *Ann N Y Acad Sci* **1033**, 30–41. PMID: 15591001.

190   Park J, Kim M, Shin H, Ahn H, Park YK (2023). Low-Molecular Collagen Peptide Supplementation and Body Fat Mass in Adults Aged ≥ 50 Years: A Randomized, Double-Blind, Placebo-Controlled Trial. *Clin Nutr Res* **12**, 245–256. PMID: 37969940.

191   Market Research Future Global Weight Loss Products Markets Overview. https://www.marketresearchfuture.com/reports/weight-loss-ingredients-market-4772.

192   Australian Bureau of Statistics (2023). National Study of Mental Health and Wellbeing. https://www.abs.gov.au/statistics/health/mental-health/national-study-mental-health-and-wellbeing/latest-release.

193   Euromonitor International (2023). Delightful Distractions. https://lp.euromonitor.com/white-paper/2024-global-consumer-trends/delightful-distractions.

194   Forbes SC, Cordingley DM, Cornish SM, Gualano B, Roschel H, Ostojic SM et al. (2022). Effects of Creatine Supplementation on Brain Function and Health. *Nutrients* **14**, 1–16. PMID: 35267907.

195   Fact.MR (2023). Mood Support Supplements Market. https://www.factmr.com/report/mood-support-supplements-market#:~:text=Newly-released mood support supplements,the end of forecast period.

196   Onaolapo AY, Obelawo AY, Onaolapo OJ (2019). Brain Ageing, Cognition and Diet: A Review of the Emerging Roles of Food-Based Nootropics in Mitigating Age-related Memory Decline. *Curr Aging Sci* **12**, 2–14. PMID: 30864515.

197   Zwilling CE, Wu J, Barbey AK (2024). Investigating nutrient biomarkers of healthy brain aging: a multimodal brain imaging study. *npj aging* **10**, 27. PMID: 38773079.

198   Zhou L, Bai X, Huang J, Tan Y, Yang Q (2023). Vitamin B12 supplementation improves cognitive function in middle aged and elderly patients with cognitive impairment. *Nutr Hosp* **40**, 724–731. PMID: 37334792.

199   Yang Y, Choi H, Lee C-N, Kim YB, Kwak YT (2018). A Multicenter, Randomized, Double-blind, Placebo-controlled Clinical Trial for Efficacy of Acetyl-L-carnitine in Patients with Dementia Associated with Cerebrovascular Disease. *Dement Neurocogn Disord* **17**, 1–10. PMID: 30906386.

200   Li S, Guo Y, Men J, Fu H, Xu T (2021). The preventive efficacy of vitamin B supplements on the cognitive decline of elderly adults: a systematic review and meta-analysis. *BMC Geriatr* **21**, 367. PMID: 34134667.

201   Alghamdi A (2023). Structural and Functional Brain Changes Associated with Vitamin B12 Deficiency using Magnetic Resonance Imaging: A Systematic Review and Meta-analysis. *Curr Med Imaging* **19**, 312–326. PMID: 35578857.

202   Huang F, Guan F, Jia X, Zhang J, Su C, Du W et al. (2024). Dietary Choline Intake Is Beneficial for Cognitive Function and Delays Cognitive Decline: A 22-Year Large-Scale Prospective Cohort Study from China Health and Nutrition Survey. *Nutrients* **16**, 2845. PMID: 39275163.

203   Genchi G, Lauria G, Catalano A, Sinicropi MS, Carocci A (2023). Biological Activity of Selenium and Its Impact on Human Health. *Int J Mol Sci* **24**, PMID: 36768955.

204   Marchetti MF, Silva GM da, Freiria CN, Borim FSA, Brito TRP de, Milanski M et al. (2022). Association between zinc deficiency and cognitive decline in community-dwelling older adults. *Cien Saude Colet* **27**, 2805–2816. PMID: 35730848.

205   Ambrogini P, Betti M, Galati C, Di Palma M, Lattanzi D, Savelli D et al. (2016). α-Tocopherol and Hippocampal Neural Plasticity in Physiological and Pathological Conditions. *Int J Mol Sci* **17**, PMID: 27983697.

206   Zhang X-X, Wang H-R, Meng-Wei, Hu Y-Z, Sun H-M, Feng Y-X et al. (2024). Association of Vitamin D Levels with Risk of Cognitive Impairment and Dementia: A Systematic Review and Meta-Analysis of Prospective Studies. *J Alzheimers Dis* **98**, 373–385. PMID: 38461506.

207   Chen WY, Cheng YC, Chiu CC, Liu HC, Huang MC, Tu YK et al. (2024). Effects of Vitamin D Supplementation on Cognitive Outcomes: A Systematic Review and Meta-Analysis. *Neuropsychol Rev* **34**, 568–580. PMID: 37418225.

208   Sherzai D, Moness R, Sherzai S, Sherzai A (2023). A Systematic Review of Omega-3 Fatty Acid Consumption and Cognitive Outcomes in Neurodevelopment. *Am J Lifestyle Med* **17**, 649–685. PMID: 37711355.

209   Xu C, Bi S, Zhang W, Luo L (2024). The effects of creatine supplementation on cognitive function in adults: a systematic review and meta-analysis. *Front Nutr* **11**, 1424972. PMID: 39070254.

210   Wang W, Pan D, Liu Q, Chen X, Wang S (2024). L-Carnitine in the Treatment of Psychiatric and Neurological Manifestations: A Systematic Review. *Nutrients* **16**, 1–37. PMID: 38674921.

211   Grand View Research (2024). Brain Health Functional Food And Beverage Market Size, Share & Trends Analysis Report By Ingredient (Choline, Curcumin), By Product (Dairy, Bakery), By Distribution Channel (Specialty Stores, Online), And Segment Forecasts, 2023–2030. https://www.grandviewresearch.com/industry-analysis/brain-health-functional-food-beverage-market-report (accessed 13 Nov 2024).

212   Innova Market Insights (2024). Global Immune Health Trends. https://www.innovamarketinsights.com/trends/global-immune-health/ (accessed 13 Nov 2024).

213 GlobeNewswire (2024). Immunity Boosting Food Products Market Opportunities to 2033: Global Immunity Boosting Food Products Market Predicted to Reach $60.77 Billion by 2033. https://www.globenewswire.com/news-release/2024/09/23/2951292/28124/en/Immunity-Boosting-Food-Products-Market-Opportunities-to-2033-Global-Immunity-Boosting-Food-Products-Market-Predicted-to-Reach-60-77-Billion-by-2033.html#:~:text=The global immunity boo (accessed 13 Nov 2024).

214 Monteiro CA, Cannon G, Lawrence M, Costa Louzada ML, Machado PP (2019). Ultra-processed foods, diet quality, and health using the NOVA classification system. In: FAO. Rome. https://openknowledge.fao.org/server/api/core/bitstreams/5277b379-0acb-4d97-a6a3-602774104629/content.

215 Lane MM, Gamage E, Du S, Ashtree DN, McGuinness AJ, Gauci S et al. (2024). Ultra-processed food exposure and adverse health outcomes: umbrella review of epidemiological meta-analyses. *BMJ* **384**, e077310. PMID: 38418082.