

PROTEIN QUALITY

THE NUTRITIONAL ADVANTAGE OF ANIMAL-SOURCED FOODS



WHAT IS PROTEIN?

Dietary protein (termed 'protein' in this resource) falls under the wider group of macronutrients alongside carbohydrates and fats. These macronutrients are required to fuel our bodies and provide us with energy. **Protein can be found in either animal sources (e.g. red meat, fish, eggs, poultry and dairy) or plant sources (e.g. soy, legumes, peas, grains, nuts and seeds).** A healthy diet should include a variety of protein foods at all stages of life.

Proteins are long and folded chains made of amino acids, which are akin to building blocks for the body. Hundreds to thousands of these amino acids join in simple or very complex ways to produce proteins, each with a unique shape and structure¹. The protein we consume from food is an essential nutrient the human body requires to build muscle, bone, skin and hair¹.

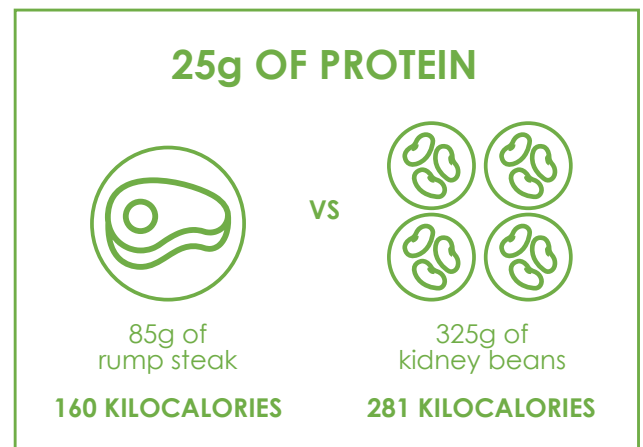
PROTEIN FOR HEALTH

Protein has a direct influence on many aspects of health, including growth and development; maintenance of chemical (hormonal) balance; supporting the immune system and acting as the building blocks of bone, muscle, skin and blood¹. There is continual turnover of protein in the body, with stores being broken down and replaced in a process called protein turnover². It is important we eat enough dietary protein to prevent breakdown of muscle.

Reasons we need protein:

- **Growth and development:** Protein is essential for the body's growth and development at all stages of life, beginning from conception through puberty, to adulthood³. Adequate amounts of protein must be consumed for optimal growth and development to take place.
- **Lean muscle mass and bone health:** Protein is essential for the maintenance and repair of muscle and our organ systems. In addition to calcium and vitamin D, protein has been shown to positively affect skeletal bone development and formation. Protein aids in building bigger and stronger muscles⁴. Protein is also crucial to prevent muscle loss and bone deterioration, which can naturally occur with ageing and is associated with frailty and increased risk of falls⁴.
- **Weight management:** Protein can increase satiety (the feeling or state of being full and satisfied) and reduce food cravings⁵. High quality animal proteins can often be lighter on calories and more nutrient dense than

plant proteins and highly processed protein sources⁶. For example, 85g of cooked, lean rump steak has 25g of protein and contains 160 kilocalories, whereas to get 25g of protein from cooked kidney beans, one would need to eat over four times the amount (325g or just over one cup) which is nearly double the calories (281 kilocalories)⁹. This feeling of fullness with less calories consumed, may aid in overall weight control.

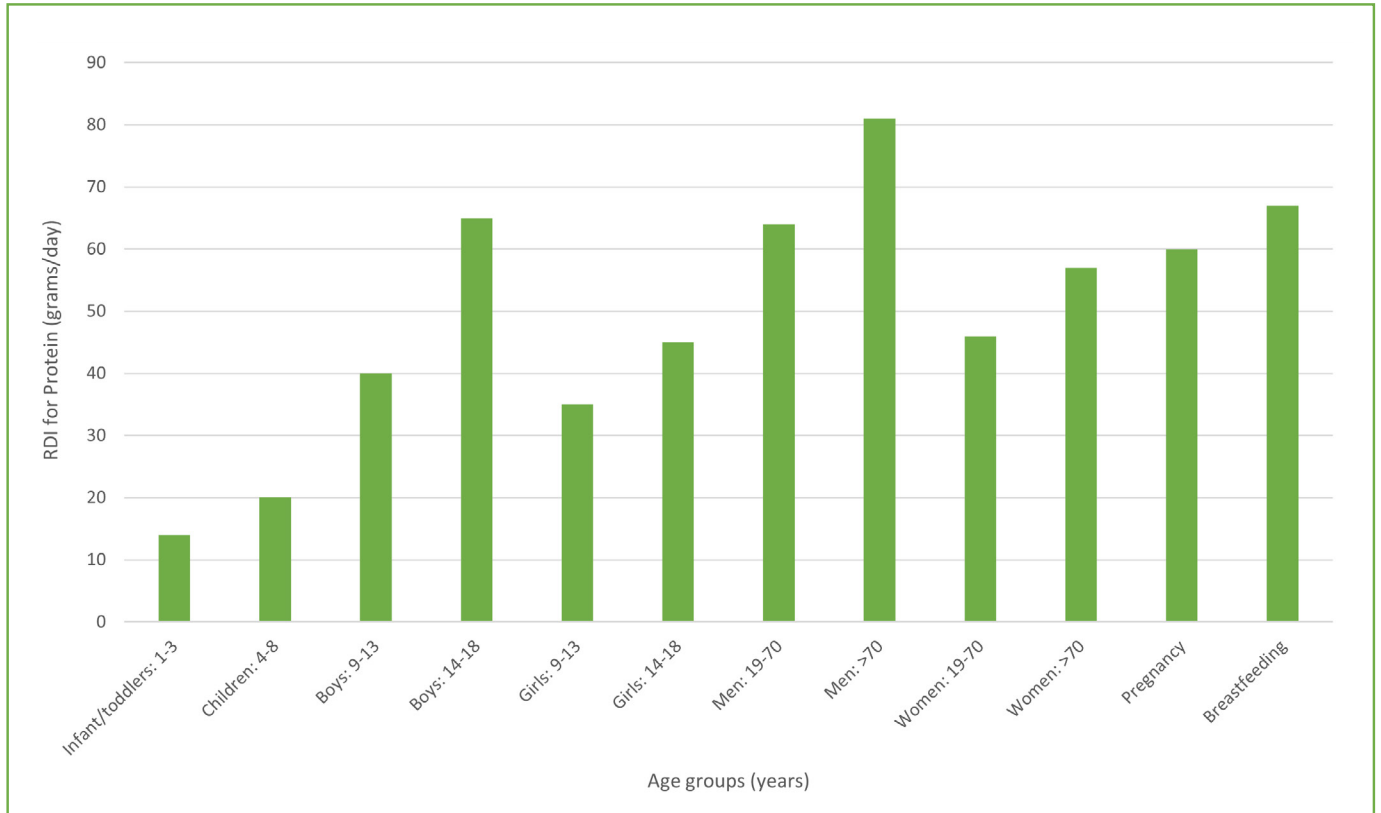


- **Cardiovascular health:** Evidence has shown higher consumption of dietary protein may decrease systolic and diastolic blood pressure^{6,7}. This is of importance to manage high blood pressure (hypertension), which has been shown to be one of the most effective ways to decrease cardiovascular disease risk⁸. For cardiovascular health, the New Zealand Heart Foundation suggests eating lean meat among other protein sources as one of a range of healthy dietary patterns. It recommends consuming less than 350g per week (cooked) spread across three meals per week (with an individual portion size of approximately 100g)¹⁰.



HOW MUCH PROTEIN DO WE NEED?

Protein is essential at all stages of life, however there are certain groups who need a little more, as seen in the graph below². Note the RDI shown on the graph below is the Recommended Dietary Intake of protein per day.



Refer to the Ministry of Health [Eating and Activity Guidelines](#) for the number of daily protein serves for each age group. The guidelines recommend adults consume up to 350-500g of cooked lean red meat per week, which equates to approximately 3 times per week. (reference number 13)



New Zealanders who need extra protein:

On the whole, most New Zealanders are meeting their protein requirements¹¹. However, for those who need extra protein to meet their needs, here are some tips:

- **Pregnant and breastfeeding women** need to get enough protein especially in the last trimester of pregnancy to meet the changing demands of both the mother and the growing baby¹². The Ministry of Health recommends pregnant women have three and a half servings of protein per day and lactating women have two and a half servings per day¹³. Having high-quality protein foods at mealtimes (e.g. lean red meat, poultry, cooked seafood, eggs) and snacking on high-quality protein foods throughout the day (e.g. nuts, yoghurt, cheese or peanut butter) will support optimal protein intake.

- **Infants and children (0-8 years)** grow and develop fast, have small stomachs and tend to feel full quickly, therefore every bite counts^{14,15}. It is important their diet contains nutrient dense foods, which help to ensure they meet their energy and nutrient requirements. In some developing countries, protein malnutrition in children leads to Kwashiorkor disease, which can lead to both physical and mental developmental delays¹. One way to make sure a child is getting enough high-quality protein is to offer it in meals and snacks, in fun and exciting ways (e.g. a boiled egg with toast soldiers, peanut butter on apple slices or make your own burgers).
- **Older children and teenagers (9-18 years)** are constantly growing, encountering puberty and can be very active¹⁴, all of which requires extra protein in the diet. According to Sport New Zealand, 92% of young people participate in play, active recreation and/or sport with an average of 11 hours each week spent doing these activities¹⁶. One way to help older children and teens meet their protein needs is to have easy grab-and-go meals (e.g. left-over spaghetti Bolognese, Shepherds pie etc) and snacks (e.g. a pottle of yoghurt, hummus and carrot sticks, beef jerky or skewers) in the fridge for them.
- **Athletes and sports people** who do vigorous, intense trainings and/or events need more protein for optimum performance, muscle repair and muscle maintenance¹⁷. One way athletes can stay on top of their protein intake is to make sure they have a small protein-rich meal and/or snack before exercise and a decent sized protein-rich meal after exercise (both with carbohydrates)¹⁸.
- **Older adults (70+ years)** can experience dental issues, limited budget, decreased appetite and changes to digestion, all of which can result in a reduction of dietary protein¹⁹. On top of this, older adults are also more prone to muscle loss and reduced strength (sarcopenia) and osteoporosis risk, therefore their protein requirements are higher¹⁹. Older adults can increase their protein intake by eating high-quality protein with each meal (e.g. 25g protein per meal) and including protein-rich snacks. For those with poor appetites, it is advised to eat the protein part of the meal first before finishing the rest of the meal. If there are dental issues, consider softer texture proteins such as eggs, mince and dairy products e.g. yoghurt^{20,21}.



HOW CAN YOU GET PROTEIN IN THE DIET?

Many foods can be a good source of protein. High-quality protein sources, such as animal proteins, are complete in amino acid profile (See 'Is all protein the same?' below) and have a much higher proportion of protein per weight or per serve, as can be seen in the table below.

Protein content (g/100g or by serve) of animal and plant protein foods⁹.

Protein serve	Protein (g)
Braised lamb shank (100g)	33.3
Grilled chicken breast (100g)	31.2
Roasted pork leg steak (100g)	30.8
Beef rump steak, fried (100g)	30.2
Canned tuna in spring water (100g)	26.6
Baked hoki fillet (100g)	22.0
Firm tofu, fried (100g)	17.9
Boiled black beans (100g)	8.9
Light blue top milk (250ml)	8.7
Boiled red kidney beans (100g)	7.9
Boiled lentils (100g)	7.6
Raw peanuts (30g)	7.3
Plain low-fat yoghurt (150g pottle)	7.2
Boiled egg (size 7)	7.0
Soy milk (250ml)	7.0
Raw almonds (30g)	6.0

Note: This table does not include all protein foods



IS ALL PROTEIN THE SAME?

There is a general misconception that all proteins have the same quality, however this is not the case.

There is a significant difference in protein quality for plant-derived and animal-derived foods which is due to their different amino acid profiles and bioavailability (the ability of the body to absorb and use protein).

Amino acid profile

There are 20 amino acids in total that combine to form a protein²². Many amino acids can be created within the body; these are called non-essential or dispensable amino acids and are not required in the diet. However, there are nine essential amino acids which cannot be formed biologically and need to be acquired through dietary intake²².

The nine essential amino acids are: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. If a protein food is inclusive of all nine essential amino acids it is considered to be a complete or high-quality protein, whereas protein foods missing one or more amino acids are considered incomplete or low-quality protein¹.

The amino acid profile of a certain food can describe the protein quality of the food. Protein testing methods, such as high-performance liquid chromatography, are used to analyse the presence and level of essential amino acids to deem a protein food to be either a complete or incomplete source of protein²³ (see Bioavailability overleaf). **Overall, animal proteins such as red meat, poultry, fish, seafood, eggs, and dairy products are generally seen as higher quality proteins when compared to plant proteins except for soya beans²³.** This is illustrated in the table below.

Daily Adult Essential Amino Acid Requirements and Protein Food Sources								
Essential amino acid	Adult requirement ²⁴ (mg/g protein/day)**	Food (mg/g protein)						
		Beef ²⁶	Lamb ²⁶	Milk ²⁵	Egg ²⁴	Soy protein ²⁵	Pea protein ²⁷	Brown rice protein ²⁷
Lysine	45	172	182	80	66	60	47	19
Leucine	59	167	165	97	83	77	57	58
Isoleucine	30	93	96	50	51	48	23	20
Valine	39	98	109	58	48	47	27	28
Phenylalanine	38	86	84	99	60	52*	37	37
Threonine	23	82	103	47	48	36	25	23
Histidine	15	85	43	30	24	26	16	15
Methionine	16	68	68	27	35	13	3	20
Tryptophan	6	25	22	13	18	13	-	-

*value is indicative of phenylalanine and tyrosine

** The requirement for each indispensable amino acid divided by the protein requirement for adults aged >18 years

Essential amino acid values obtained from raw lean tissue of New Zealand beef rump and lamb hind shanks²⁶.

Plant-based protein source amino acid profiles attained from commercially available protein isolates (concentrated protein fractions)²⁷.

Egg amino acid profile attained from raw egg proteins²⁴.

The importance of lysine

Lysine contributes to the maintenance and growth of muscle and is one of the most limited essential amino acids available in a plant-derived diet^{28,29}. In developing countries, where poverty exists and animal protein intake is limited, **lysine deficiency can lead to fatigue, nausea, poor concentration and irritability, and long term it can cause growth inhibition, anaemia, hair loss and issues with fertility**^{30,31}. It is also important to note that when protein quality is sub-optimal or limited in some way, a larger food volume is required to meet the RDI, which subsequently means higher caloric energy intake. This can be problematic for groups with low or loss of appetite or early satiety (e.g. the elderly or those with swallowing difficulties [dysphagia])²⁴.

Bioavailability

There are two common internationally recognised methods to measure protein digestibility and absorbability:

- Digestible and Indispensable Amino Acid Score (DIAAS)**. DIAAS is the protein quality ranking method recommended by the Food and Agriculture Organisation (FAO) of the United Nations and provides a score of >100 as the highest measure of protein quality being considered “excellent” quality³²⁻³⁵. A score of 75-99 is considered a “good” source of protein and a score of <75 will not have a claim attached to protein quality³²⁻³⁵. This method focusses on the digestibility and absorption of mainly essential amino acids such as valine, isoleucine, leucine, and lysine in the small intestine³³.



- Protein Digestibility-Corrected Amino Acid Score (PDCAAS)**. PDCAAS is the most common method of assessing protein digestibility and is represented by a chemical score that ranges between 0 and 1.0. A score of 1.0 means that all essential amino acids are present in amounts that meet minimum requirements for the estimated average requirements for tissue growth and maintenance^{35,36}.

The DIAAS and PDCAAS scores of commonly eaten protein foods are listed below. This suggests foods that score well on both analysis methods are the easiest dietary protein sources to digest and absorb when consumed.

Protein source	DIAAS	PDCAAS
Cow's milk (whole milk) ³⁸	114	1.0
Egg (Hard boiled) ³⁸	113	1.0
Lean beef (raw) ³⁷	111	1.0
Chicken breast ³⁹	72	1.0
Cooked kidney beans ³⁹	59	0.65
Soy protein isolate ³⁸	98	0.90
Cooked rice ³⁸	59	0.62
Cooked peas ³⁸	58	0.60
Wheat ³⁷	40.2	0.46

The cooking method of beef can affect the DIAAS. A New Zealand study, using the pig model for adult humans, found the DIAAS was greater for raw, boiled, and pan-fried beef than for roasted and grilled beef. However, the high DIAAS range across all cooking conditions confirms that beef is a high-quality protein source⁴⁰.

Whilst animal proteins score higher for both DIAAS and PDCAAS, it is recognised that whole food proteins are more than just their constituent amino acids. They also contain other non-protein nutritive components such as vitamins, minerals, and for plant-based protein, fibre (missing in animal-based proteins), so it is important to include a range of proteins from both animal and plant sources in a diet.

WHY RED MEAT?

- Lean red meat, such as New Zealand pasture-fed beef and lamb, is a **high-quality and nutrient dense source of protein**. It is complete in essential amino acids and scores among the highest of common protein foods for digestibility and absorption on both DIAAS and PDCAAS protein analysis methods.
- Lean red meat is **light on calories** yet protein and nutrient dense. For example, when comparing 100g of cooked lean rump steak to 100g of cooked lentils, one would need to eat approximately four times the amount of lentils (or one can of lentils) and over twice the amount of calories (420kcal) to get the same amount of protein as the rump steak⁹. Combining meat with pulses (e.g. a lentil and mince cottage pie) is a good way to get more protein, a range of nutrients and more fibre.
- Lean red meat is **packed full of other essential micronutrients such as vitamins and minerals that are important for a healthy and balanced diet**. Red meat is a good source of vitamin B₁₂, bioavailable iron and zinc while also being a source of other minerals and vitamins such as selenium, B vitamins and vitamin D⁴⁷⁻⁴⁹.



PROTEIN, ENVIRONMENT AND GLOBAL HEALTH

Although plant proteins serve an important purpose for global protein supply, recent studies have shown that a radical reduction of animal-based proteins may be problematic⁴². The transition from animal proteins to plant-derived proteins has been proposed to tackle the global warming crisis^{43,44}. This notion mainly comes from the identification that lower greenhouse gas emissions (GHGE) per calorie are emitted with plant-based diets, over diets including animal products. However, as one recent study has shown when you look beyond calories alone and take into account protein quality (GHGE per total amino acids), the opposite pattern was found with lower GHGE from meals inclusive of animal products compared to strictly plant-based meals⁴⁵. This suggests eating high-quality protein sources could have lower GHGE when compared to plant-based protein foods needed for the same amount of amino acids.

Soya is the only complete plant-based protein available, therefore the suggestion for a complete shift towards plant-based protein diets could lead to a global deficiency in certain essential amino acids, such as lysine⁴⁴.

Protein sources that can supply lysine in adequate amounts are mainly animal-based products, and therefore an extreme reduction of these products could have a detrimental effect on global nutritional status⁴². To optimise the nutritional adequacy of future generations, moderate amounts of high-quality protein sources, such as New Zealand pasture-fed beef and lamb along with other animal and plant proteins, should be considered as part of a healthy, varied and well-balanced diet.

The environmental impact of food has become of greater interest in the quest to encourage foods that meet human health needs with the lightest environmental footprint. **Since 1990, the New Zealand sheep and beef sector have made significant environmental changes to optimise agricultural productivity and reduce GHGE by 30%⁴¹. This progress is working towards a sector goal of being carbon neutral by 2050.** Through collective efforts from farmers, government, consumers and food industry partners, such as Beef + Lamb New Zealand, more environmentally conscious farming strategies have been identified and adopted. *For more information on environmental impacts and sustainability of sheep and beef farming visit: <https://www.beeflambnz.co.nz/sustainability>*



KEY MESSAGES FOR HEALTH PROFESSIONALS

- **Protein is an essential nutrient required at every age and stage. It is particularly important for pregnant and breastfeeding women, growing children and teenagers, athletes and older adults.**
- **All age groups should aim to incorporate some protein at all meals and snacks to help meet nutritional and energy requirements.**
- **Lean red meat is protein dense, nutrient rich and calorie light. As per Ministry of Health Eating and Activity Guidelines, up to 500g cooked, lean red meat can be enjoyed each week¹³, or in other words, about 3 times per week as part of a varied, balanced and healthy diet.**
- **Not all protein sources have the same quality. Animal sourced proteins are a:**
 - **High-quality protein source that provide the full array of essential amino acids and other important nutrients, such as bioavailable iron, vitamin B₁₂ and zinc.**
 - **Top scorer for protein digestibility and absorbability.**
 - **Richer source of protein per gram compared to plant protein sources, meaning you don't need to eat as much.**
- **For people who choose to avoid eating animal sourced foods, consider supporting them with meal planning to combine a range of plant foods. Dietary advice from a Registered Nutritionist or Registered Dietitian may be beneficial.**

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