Protein requirements

Dr Jane K Philpott MA (Oxon), MSc, PhD, gives us the lowdown on protein

Almost every standard source of information on nutrition, whether in schools or in texts and articles, emphasises the need for adequate protein. "If you don't eat your meat, you won't grow" is a familiar mantra at mealtimes.

The word "protein" is derived from the Greek proteios or "primary", reflecting its paramount importance for our survival. The body manufactures proteins to make up hair, muscles, nails, tendons, ligaments and other body structures. Proteins also function as enzymes, hormones and other important components of our cells, such as our genes. The human body contains somewhere between 30,000 and 50,000 unique proteins. The building blocks of all proteins are molecules known as amino acids; there are 20 amino acids of relevance to human nutrition.

During a single day, about half a kilogram of an adult's body protein is broken down into amino acids and reassembled into new proteins. This is done to maintain the supply of proteins used on a daily basis and to replace those lost in urine, faeces and through the skin. This protein turnover enables us to grow, reproduce, repair, and internally defend ourselves on a continual basis. Although we can manufacture some amino acids, adequate dietary intake is necessary to provide us with those amino acids we cannot make; these are called essential amino acids and there are eight of them.

So what is an adequate dietary intake of protein? Do athletes and body builders need more protein than others? Do vegetarians and vegans risk protein deficiency? And is too much protein harmful for health?

Physical activity is the most important lifestyle influence on demand for protein

The amount of protein needed in a person's daily diet is determined by overall energy expenditure, and by the body's need for nitrogen and essential amino acids. Physical activity is the most important lifestyle influence on demand for protein. Requirements are also greater during childhood for growth and development, during pregnancy or when breast-feeding in order to nourish a baby, or when the body needs to recover from malnutrition, infection or trauma, or after an operation (1).

Protein-deficient diets are almost certain to be generally nutrient-poor diets, which are deficient to varying degrees in energy and a range of other nutrients. In children, syndromes that have been associated with protein deficiency, such as stunting and kwashiorkor, are now believed to reflect complex interactions between multiple deficiencies and other adverse environmental factors, including infection (1).

If inadequate energy is taken in through diet, as in the process of starvation, the body will use protein from the muscle mass to meet its energy needs, leading to muscle wasting over time. If inadequate protein is consumed, muscle will also waste as vital cellular processes recycle muscle protein for their own requirements.

Protein requirements are expressed as absolute intake (grams per day), intake per unit body weight (grams per kilogram per day) and intake as a percentage of total energy.

The first internationally recommended allowance for the protein needs of human adults as proposed by the League of Nations in 1936 was not less than 1 g of protein per kilogram of body weight per day (2). Subsequent estimates made by a series of international expert groups have been lower (3). The 1973 FAO/WHO Expert Committee was the first with access to sufficient data to permit a factorial calculation of protein requirements, and it arrived at a figure 20 percent lower than that previously recommended, namely 0.75 g per kg per day (4).

This figure of 0.75 g per kg per day is used in the UK government dietary guidelines, which indicate that females aged 11 to 50+ years require between 41.2 and 46.5 grams protein per day, whilst males of 11 to 50+ years require

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42.1 to 53.3 g protein per day. Children from 0-3 months to 7-10 years require between 12.5 to 28.3 g protein per day. Pregnancy requires an additional 6 g protein per day, and lactation between 8 and 11 g additional protein per day. The guidelines suggest that 15 per cent of total energy intake should come from protein; protein provides 4 calories per gram (5).

These levels of protein are relatively easy to obtain from modern diets with sufficient calories. Indeed, the most recent National Diet and Nutrition Survey in the UK suggests that average protein intake is 85 g protein per person per day (17.6% of total energy), which is well above the dietary reference value (6).

- A large egg contains 6 g protein
- 2 slices of bread contain 6 g protein
- 6 fl oz (170ml) milk contains 6 g protein
- 100g (4oz) chickpeas contains 16 g protein
- A tin of tuna contains 20 g protein
- 100g (4oz) tofu contains 20 g protein
- 170g (6oz) beef contains 40 g protein

A question frequently asked is whether increasing protein intake is of benefit to those with high levels of physical activity, such as athletes and body builders. In fact, a nutritionally complete mixed diet (eg, 14% protein calories) fed to physically active individuals at energy balance (eg, twice the basal metabolic rate) will require about 1.7g protein per kg per day, which is more than twice the normal guideline amount (7).

Furthermore, it has long been known that marked strength gains with appropriate resistance exercise can occur on very modest protein intakes of about 0.8 g protein per kg per day (8). While there are no reported controlled dietary trials of protein intake and performance per se, a meta-analysis of dietary supplements and lean mass and strength gains with resistance exercise, confirmed that protein did not have a significant effect on lean gain or strength (9).

UK government guidelines state there is little firm evidence to set an upper safe limit for protein, but conclude that it is prudent for adults to consume no more than 1.5 g protein/kg/day (5). Some body builders are, however, reported to consume as much as 4 g protein/kg/day. Other people consume high protein diets in order to lose weight.

Protein can help weight loss for two reasons. First, high protein foods slow the movement of food from the stomach to the intestines, so you feel full for longer. In addition, protein helps to regulate blood sugar, thereby reducing the sugar 'highs' and 'lows' which can contribute to cravings and hunger pangs.

Safety of very high protein diets is, however, a cause for concern. There are various reports linking excess protein to osteoporosis, kidney stones, cardiovascular disease and cancer, though the evidence is equivocal (1) (10). Protein is a major source of net endogenous acid production (through sulphate excretion), which can adversely affect bone

Nuts - an excellent choice of protein-rich food

When choosing protein-rich foods, pay attention to what comes with the protein

mineral density unless balanced by dietary base, for example, potassium salts of weak organic acids abundant in fruit and vegetables (11). High protein diets can increase exercise-induced amino acid oxidation in the untrained, and in individuals with inadequate energy intake. They can also increase risk of negative nitrogen balance and loss of lean body mass between training periods when high intakes are reduced (12). Furthermore, protein, especially a 'fast' protein such as whey, is the most satiating macronutrient, and protein supplements may lead to suboptimal intakes of those starchy foods essential for both high performance and long term health.

Another question often asked is whether there is any difference between animal protein and plant protein with regard to health. The theoretical answer is no, if one considers just the protein per se. Both animal and vegetable protein sources can all provide the 20 amino acids necessary for the body, including the eight essential ones. Different proteins do, however, contain different proportions of the amino acids. With plant proteins, it is usually necessary to combine foods to ensure adequate levels of all the essential amino acids in one meal; plant proteins are thus sometimes described as 'incomplete'. With animal proteins, sufficient levels of the essential amino acids are usually present in a single food, and they are said to be 'complete'. For example, to obtain vegetable protein with an amino acid profile similar to meat, one may choose a grain (eg rice) and a legume (eg bean) in a ratio of approximately two parts grain to one part legume. Using nuts or seeds with grains also increases the amino acid spectrum. It is therefore easily possible to obtain sufficient protein on a vegetarian or vegan diet, provided that a variety of whole grains, beans, nuts and seeds is consumed.

In practice, however, the situation is more complex because proteins in food never exist on their own, but are packaged together with other nutrients, such as fat, fibre, vitamins and minerals. Research shows that what really matters for health is the protein package (10). Beef is a good source of complete animal protein. It is also an excellent source of saturated fat. If eating beef, it is thus best to choose the leanest cuts. Chicken,

turkey and fish are better options. Milk and other dairy products are also high in saturated fats so, for health reasons choose skimmed or semi-skimmed milk, and low fat yoghurts and cheeses. Beans, nuts, whole grains and other vegetable sources of protein are better still, because they are generally low in saturated fat and high in fibre, vitamins, minerals and essential fatty acids.

The scientific consensus is that eating more plant foods and less animal and processed foods best promotes healthy longevity. This consensus is based on research relating dietary factors to chronic disease risks, and to observations of exceptionally low chronic disease rates among people consuming vegetarian, Mediterranean and Asian diets (13). For example, men whose diets include a lot of red meat – more than 110g (4 oz) per day – and dairy products seem to be more likely to develop prostate cancer, especially metastatic types, than men who eat less meat and dairy products (10). There are thus strong indications that it is not just the quantity of protein that is important for health, but also the source of the protein.

In conclusion, we need a minimum amount of protein each day – approximately 0.75g protein per kg body weight – but almost any reasonable diet will provide this. It is important to balance protein intake with appropriate amounts and types of carbohydrate and fat. Current government guidelines suggest that 50 percent of total energy should come from carbohydrates, preferably unprocessed whole grains, fruit and vegetables; 35 percent from fat (no more than 10 percent saturated); and 15 percent from protein (5).

Eating too much protein over a prolonged period, for example, by consuming protein supplements, or the high amounts in high-protein, low-carbohydrate diets, can draw calcium out of the skeleton and possibly lead to osteoporosis and broken bones. It may also increase the risk of other health problems, such as cardiovascular disease and kidney stones, but more evidence is required to confirm this.

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When choosing protein-rich foods, pay attention to what comes with the protein. Vegetable sources of protein, such as beans, nuts, and whole grains, are excellent choices, as they also offer healthy fibre, oils, vitamins and minerals. Soya protein is a good replacement for animal protein but it is best to consume it in moderation, as the health effects of eating high levels of soya are unknown (10). Two to four servings of a soya-based food such as miso or tofu per week is a good target. The best animal protein choices are fish and poultry. If you are partial to red meat, stick with the leanest cuts, choose moderate portion sizes, and make it only an occasional part of your diet. ■

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