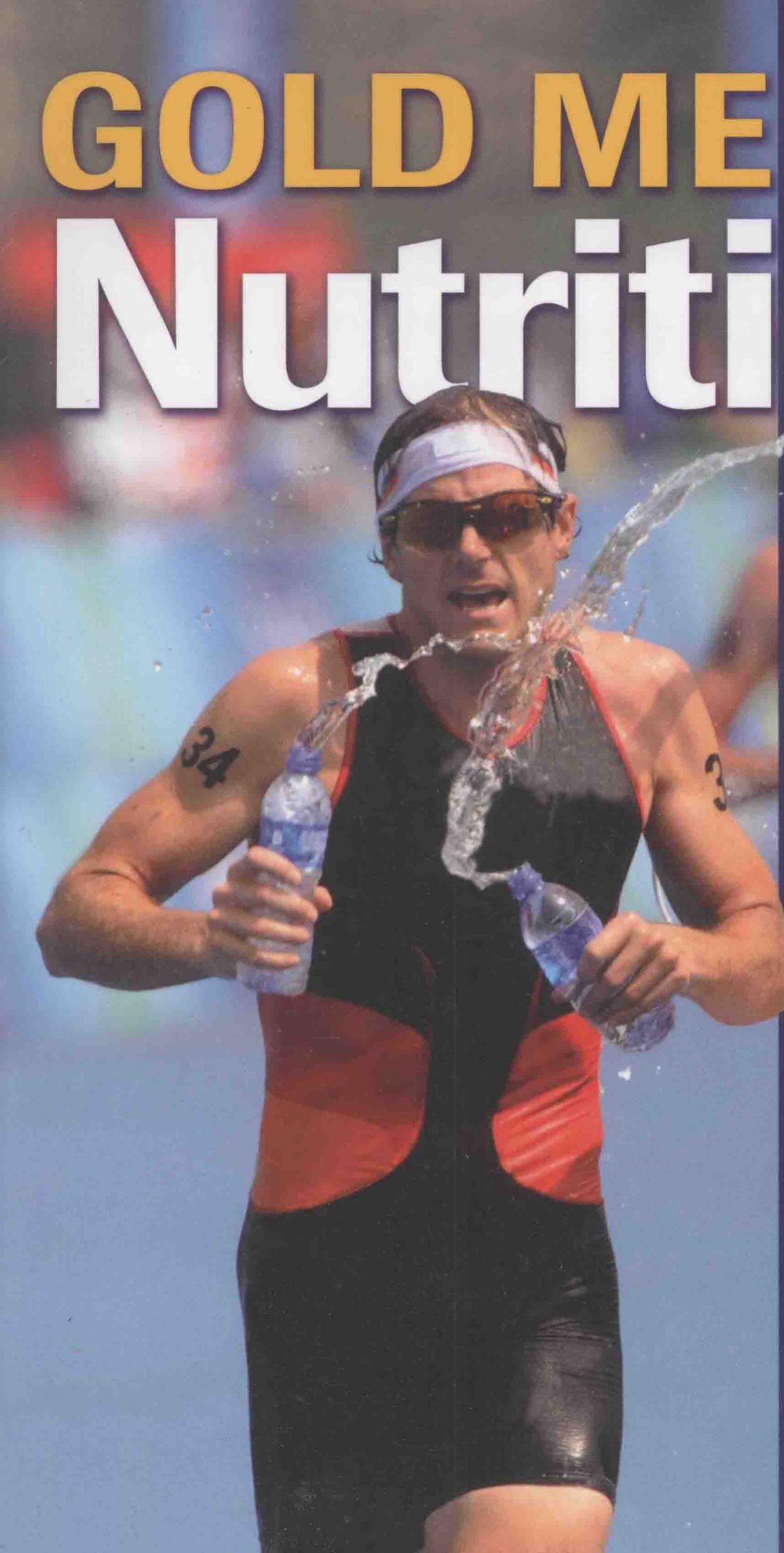
GOLD MEDAL Nutrition

Fifth Edition



Glenn Cardwell

Gold Medal Nutrition

FIFTH EDITION

Glenn Cardwell, APD

Nutrition Impact

运动与营养

Gold Medal Nutrition-5th Edition

Human
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This edition is dedicated to Sports Dietitians Australia, the dietitians who created the organisation in 1996, and the team that keeps it a leading professional sports nutrition body today.

Foreword

Glenn and I live on opposite sides of a big country, so we sadly don't get to see each other that often. Recently, however, we got together to celebrate a happy occasion: the 15th anniversary of the creation of Sports Dietitians Australia, the professional body to which this book is dedicated. It can be quite jarring to look back over old photos of yourself. The clothes! The hair! (Except for Glenn, of course.) What were we thinking?

Gold Medal Nutrition is a testament to our changes in thinking about sports nutrition. The various editions track our progress in understanding the ways that nutrition can help an athlete achieve goals in training and competition. Like previous editions, the fifth edition provides the latest evidence-based information on eating for your best outcome in sport. It's all delivered in Glenn's expert style, which means that complicated stuff becomes understandable, even the most mundane stuff becomes memorable, and the factual stuff becomes practical to achieve.

I have always learned new things by reading *Gold Medal Nutrition*. Each successive edition has collated new or updated information, demonstrating the exciting and evolving nature of the science of sports nutrition. Who would have thought at the time of the fourth edition that we would be talking about beetroot juice or worrying about athletes who trained indoors? Yet nitrate supplementation and vitamin D status are now the hottest of topics at conferences and sports institutes.

Of course, data are only as good as the practice they allow or inspire. Here is where *Gold Medal Nutrition* is at its best. Glenn presents facts on sports nutrition with the insight of someone who has worked at the coalface of elite sport, understood the passion of the weekend warrior and been blessed with the skills of an entertainer. The book is filled with information that helps athletes translate concepts into activities and convert present eating patterns into better choices. I particularly enjoy the Final Score element. After you take the journey through the narrative and fascinating sidebars of each chapter, it is good to be able to cut straight to the bottom line and to check off your understanding.

It has been exciting to be part of the journey of sports nutrition and to see it has grown both in sophistication and recognition. *Gold Medal Nutrition* has played a role in this journey, and I hope to see the number of editions continue into double figures!

Louise Burke, OAM, PhD, APD
Fellow of SDA
Head of Sports Nutrition
for Australian Institute of Sport

Preface

Back in the early 1980s, a colleague of mine suggested we run a marathon. Purchasing the only two books we could find on eating and sport, we set about learning about the best nutrition to complete the distance. They told us that sports drinks were of little value, that fit people could safely lose 4 to 5 per cent of their body weight through sweating before their performance is affected and that athletes probably need less protein than sedentary people because they use protein more efficiently. These books were based on the very little research available at the time. Today, we know differently. There is a huge foundation of research on nutrition and hydration for sports performance, so our advice has greatly improved, yet there is so much more to learn. Now, virtually all elite athletes use the services and advice of sports dietitians and adhere to the nutrition guidelines in this book. Guidelines are the best anyone can offer in a book because athletes differ greatly. Some sweat heavily, whereas others seem to lose very little sweat; as a result, fluid intake advice is going to be different for different athletes. Some will respond to a creatine supplement; others won't. Specific monitoring by a sports dietitian will be invaluable, as will personal experimentation within the guidelines at training sessions.

This fifth edition of *Gold Medal Nutrition* is divided into three parts. Part I discusses the fuel systems used in generating muscle power and gives the principles of good nutrition for healthy body function. It then covers the key aspects of sports nutrition, such as how much carbohydrate, protein, fluid and the key minerals are needed for peak performance, whether for endurance, strength or speed. There has been both confusion and great debate about the athlete's needs for protein, carbohydrate and fluid, and this section makes a big effort to clarify the science.

Part II gets into the practical side of sports nutrition: cooking and the food purchasing habits needed to perform at one's best at training and in competition. Starting with the digestive process, it details the best times to eat meals and snacks so they enhance performance, and how to deal with the all-too-common gastrointestinal distress many athletes experience. You will learn the best nutrition to have before, during and after the event. One chapter discusses the best nutritional supplements for your sport and why some supplements are unlikely to improve your performance.

The final part covers a concern of most athletes—how to control their body fat stores and gain muscle, if necessary. This issue is perhaps the hardest for many athletes. The body seems to have a preconceived view of how much body fat to store. This level of body fat may not be what judges, coaches or the athlete deems ideal. Athletes sometimes must accept a compromise, as getting too lean can weaken performance just as can carrying too much body fat. Increasing muscle mass sounds simple in principle, but it is hard work, and there is a limit to what good nutrition can do. Weight training is going to be the main contributor to an increase in muscle mass.

The first edition of this book, written in 1996, was a small publication for fitness leaders and students looking for a simple explanation of the basics of nutrition for sports performance. The book became so popular that second and third editions were produced in 1999 and 2003. Readers said they loved it because, unlike a textbook, it was easy to read and understand, it was fun and it cut straight to the key points. With international interest, the fourth edition was taken over by Human Kinetics and was expanded to cater to all students of the topic. It was so popular that this fifth edition was requested. Although

it has an Australasian bent, the principles are universal and are based on research conducted throughout the world.

Thanks must go to Chris Halbert for her continued support of the manual. I am most grateful to Mike Bahrke and Chris Drews for making the fourth edition a wonderful template for the fifth edition, admirably managed by Anne Hall. Their efforts have greatly improved the manual for an international audience. Many of my sports nutrition colleagues from around the globe have given me tips and ideas to place in the manual. The members of Sports Dietitians Australia, the first exclusively sports nutrition professional organization in the world, have been frequent sources of inspiration.

You are most welcome to send in ideas to include in the next edition. Although many websites and books profess to give information on sports nutrition, sadly, very few provide high-quality, unbiased advice. For those readers who want to go deeper and broader than this book allows, please make use of the resources suggested on page 241.

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PART I

Sports Nutrition Principles for Athletes

1

Nutrition and Fuel Systems for Sport

He must rise at five in the morning, run half a mile at the top of his speed up hill, and then walk six miles at a moderate pace, coming in about seven to breakfast, which should consist of beef steak or mutton chop, under-done, with stale bread and old beer.

Captain Robert Barclay Allardice's nutrition advice to long-distance walkers (c. 1810)

If I asked you to define healthy eating, you would likely give a very acceptable answer: 'Plenty of fruits and vegetables, whole-grain cereals . . . include lean meats and dairy foods . . . go easy on the cakes and take-aways'. Basically, this is correct, but it is easy to become confused by what we hear from the media and friends and what we read in books and magazines. As a result, we often go against our basic instincts. This chapter will help you think about what foods to eat both for health and to get the best out of your body, as well as the nutrients in these foods. We will be going into more detail about the components of food in chapter 2 (protein), chapter 3 (carbohydrate) and chapter 4 (vitamins and minerals).

Good nutrition is quite simple to achieve. Eat lots of minimally processed foods such as vegetables, grains, nuts, fruits, lean meats and reduced-fat dairy foods (except Camembert and premium ice cream because they taste the best with the fat left in!). Figure 1.1 on page 4 shows the Healthy Eating Plate with the major food groups in the proportion needed for good nutrition and to fuel an active body. This Healthy Eating Plate, from the Commonwealth Department of Health and Ageing in Australia, is very similar to the food guidelines of most Western nations and is especially suited to athletes and other active people.

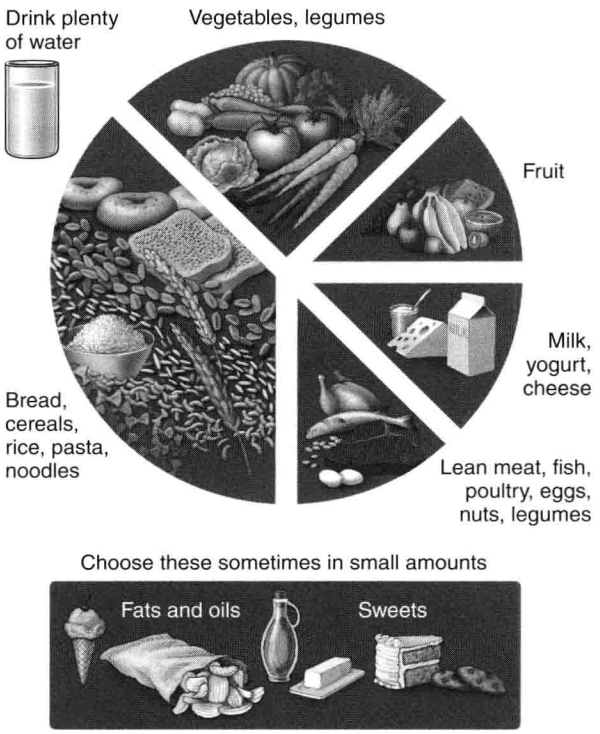

FIGURE 1.1 The Healthy Eating Plate.

Food Groups

Foods are divided into groups, each of which provides essential nutrients. The underlying science is well established and similar across every reputable health source, although health authorities sometimes differ in how they name the food groups (e.g., fruit and vegetables might be in separate groups or the same group). Table 1.1 lists the minimum serves recommended from each food group for good health.

Fruit, Vegetables and Legumes

This group should make up about a third of what you eat because it plays an essential role in protecting the body from disease now and in the future. This group is the major source of antioxidants and fibre in your diet. These foods also provide appreciable amounts of essential minerals and vitamins. The legumes can be a major protein source for vegetarians (legumes are beans such as kidney beans, lentils and baked beans). This food group is underconsumed by many people in the Western world. Eating more fruit and vegetables can be the single biggest nutritional improvement many people can make. Around the world, 'Eat more fruit and vegetables' campaigns encourage people to eat two serves of fruit (about 300 g [10 oz]) and at least 2 cups of vegetables (about 400 g [14 oz]) each day. Australia has the Go for 2&5 campaign (2 serves of fruit and 5 serves of vegetables; www.gofor2and5.com.au), the USA has the 5 A Day campaign (www.cdc.gov/nccdphp/dnpa/5aday/) and the UK promotes five portions a day (www.eatwell.gov.uk/healthydiet/nutritionessentials/fruitandveg/; www.nhs.uk/Livewell/5ADAY/Pages/Whatcounts.aspx).

▶ **One serve of fruit**
150 g or 5 oz (e.g., 1 medium apple or orange or 2 apricots or 1 cup canned fruit); one serve of vegetables = 1/2 cup cooked vegetables or legumes or 1 cup salad

Bread and Cereals

This group should also comprise around one third of the diet. It includes pasta, rice, bread, breakfast cereals, muesli and porridge. This group is also a major source of fibre for regularity and general bowel health. Breads and cereals provide some antioxidants, especially in the least processed, whole-grain variety. These foods are your best carbohydrate source; they get broken down to glucose, the main fuel source for active muscles, the liver and the brain.

Some people suggest cutting down or cutting out carbohydrate foods to be healthy and lose weight. In reality, if you do so, you are cutting down on fibre and muscle fuel, making you more prone to tiredness and constipation! High-carbohydrate foods are only likely to make you fat if you are inactive or they come with a lot of added fat, such as pastries and cakes. The least processed grain and cereal foods provide

TABLE 1.1 Minimum Serves From Each Food Group for Good Health

Fruit	Vegetables	Bread, cereals	Milk, yogurt, cheese	Meats, legumes	Oil, fat	Treats
2	5	4	2	1	1	1

more nutrients per serve than biscuits, cookies or pastries.

▶ **One serve of breads and cereals**
2 slices of bread; 1 bread roll; 1 cup of cooked pasta, rice or porridge; or 40 g (1.4 oz) breakfast cereal

Milk, Yogurt and Cheese

Dairy foods are your main source of calcium and also provide an appreciable amount of riboflavin and protein. I recommend the lower-fat varieties of milk and cheese because they provide less saturated fat and more protein and calcium. Virtually all reduced-fat milks and yogurts have more protein and calcium than the regular versions. Some milks are specifically calcium fortified, allowing you to get up to 400 milligrams of calcium in a 200-millilitre glass. If you don't fancy dairy foods, then take some calcium-fortified soy drinks as a substitute. (Make sure soy drinks state that they are calcium fortified on the label because there is very little naturally occurring calcium in soy.)

▶ **One serve of dairy**
1 cup milk; 1 cup calcium-fortified soy drink; 40 g (1.4 oz) cheese; or 200 g (7 oz) yogurt

Lean Meat, Fish, Poultry, Eggs, Nuts and Legumes

This group of foods is very important in providing protein and essential minerals. Lean meat is a very good source of easy-to-absorb iron and zinc. Fish have gained prominence because the omega-3 fat found in cold-water fish has been strongly linked to a reduced risk of heart attacks. Eggs, nuts and legumes are very important protein sources for many vegetarians. Both nuts and legumes provide fibre and antioxidants, so it is no surprise that they appear to lessen the risk of heart disease, some cancers and possibly diabetes. You will often see legumes listed with protein foods and also in the vegetable group because they are a very important source of protein in vegetarian diets, while providing fibre and nutrients common to vegetables.

▶ **One serve of meats**
100 g (3.5 oz) cooked meat, chicken; 120 g (4.2 oz) cooked fish; 2 eggs; 1/2 cup legumes; or 1/3 cup nuts

Oil and Fat

Oil and unsaturated margarine provide vitamins D and E and help improve the flavour of many foods. Oil is 100 per cent fat, whereas butter and margarine are around 80 per cent fat. 'Light' margarine may be as low as 40 per cent fat with some of that fat being replaced by water. Most people need to limit oil and fat because they are high in energy (kilojoules/calories), although athletes can afford a higher fat intake because they are likely to burn it up in training. Note: Technically, *calories* is often capitalised when referring to kilocalories, but in keeping with common public usage of the term, in this book we will use *calories* to mean kilocalories, even though it is not capitalised. However, kilojoules are never referred to as joules; hence, we use the term *kilojoules* for countries that use metric.

▶ **One serve of oil and fat**
1 tbsp oil, butter, margarine or 1 1/2 tbsp reduced-fat spread

Treats

OK, this is not really a food group, but many people enjoy treats in small amounts during or between meals. Some treats provide essential nutrients. Ice cream provides calcium and protein and is a nutritious dessert with canned fruit. Chocolate provides essential vitamins and minerals, along with antioxidants (in dark chocolate, in particular), but being 30 per cent fat, it cannot be eaten in large amounts. Biscuits, cookies, cakes, pastries, pies and take-aways are often high in saturated fat, salt or both; these should be enjoyed, but greatly limited.

▶ **One serve of treats**
25 g (0.9 oz) chocolate; 40 g (1.4 oz) cake; 30 g (1 oz) crisps; 1 doughnut; one 375 mL (12.7 oz) can soft drink; 200 mL (7 oz) wine; 400 mL (13.5 oz) regular beer; 12 hot chips or french fries; or 2 cream cookies or biscuits

Water

Yes, water is a nutrient and a most essential one as well. Your body loses fluid each day through exhaled air, urine, sweat and feces. These losses vary depending on the air temperature and how much sweat you lose each day, but a loss of 1,500 to 3,000 millilitres (3 to 6 pints) of water a day is an average range for active people. You

can get your fluid needs from water, tea, coffee, fruit juice, cordial, soft drinks, sports drinks and high-water foods such as milk, ice cream, fruits, vegetables and soup. Water requirements are discussed later in the chapter.

Essential Components of Food

Food comprises protein, fat, carbohydrate, fibre, vitamins, minerals and many bioactive compounds such as the antioxidants found mainly in fruits and vegetables. Alcoholic drinks also include alcohol (ethanol), which is technically a nutrient. We will look at each nutrient in turn.

Protein

Protein is composed of long chains of amino acids (see figure 1.2). Amino acids are the building blocks that make up large protein molecules. The digestive process breaks the protein mainly into groups of one, two or three amino acids, which are then absorbed from the intestine and into the blood to be made into body proteins such as haemoglobin, ferritin, antibodies, enzymes, hair and muscle. Some amino acids must come from food (indispensable, or essential, amino acids), whereas the body can make the others (dispensable, or nonessential) even though they still come from food.

Protein has many functions in the body:

- Enzymes are forms of protein that enable chemical reactions to take place in the body; they are involved in the digestive breakdown of food via digestive enzymes.
- Cell membranes, tendons and cartilage are composed of structural protein.
- Blood has important forms of protein, such as haemoglobin, which transports oxygen around the blood; transferrin is a protein that transports iron around the body; and albumin is a protein that controls water balance in the cells.
- Antibodies are a specialised form of protein that helps protect us from disease.
- Muscle strength comes from the contractile proteins actin and myosin, which allow muscles to contract and relax in exercise.
- Skin, nails and hair are made of strong proteins that can cope with the rigours of daily life.

In Western countries, animal foods provide most of the protein. Foods such as meat, chicken, fish, milk, cheese, yogurt and eggs have protein that provides all of the essential amino acids for life (see table 1.2). This is not to discount other valuable sources of protein. About one third of our protein comes from cereal foods (e.g., bread, rice), legumes, fruits and vegetables. Some plant foods will be low in some of the essential amino acids. A combination of plant foods, however, can provide all of the essential amino acids at one meal (complete protein). Some examples are legumes with cereal foods (e.g., beans on toast, lentils with rice) and seeds or nuts with grains (e.g., peanut butter sandwich). In some countries, rice and beans are a major source of complete protein.

If we eat more protein than we require, the excess protein is used as muscle fuel (glucose) during exercise or possibly stored as body fat (but not muscle). Most people, even vegetarians, have no difficulty eating enough protein each day, and protein deficiency is rare in Western

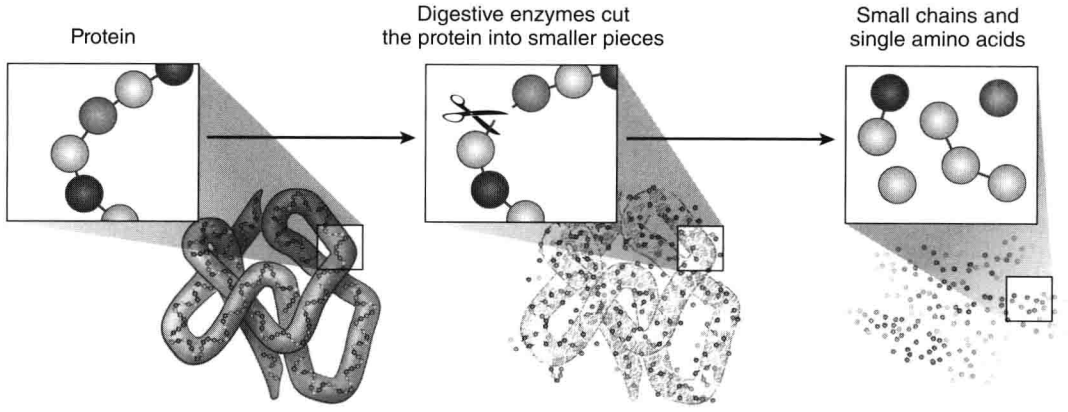

FIGURE 1.2 Through digestion, chains of amino acids in protein are broken down into small chains or single amino acids. They are then absorbed into the blood to be made into body proteins.

TABLE 1.2 Protein in Food

Good sources	Moderate sources
Meat	Bread
Chicken	Breakfast cereal
Fish	Rice
Seafood	Pasta
Cheese	Oats
Milk	Legumes (e.g., baked beans, lentils)
Milk powder	Nuts
Yogurt	Seeds
Eggs	

countries. Those who may be at risk of low protein are those who eat no animal foods (vegans) and those on highly restrictive weight loss diets.

We discuss amino acids and protein needs, as well as protein supplements, in chapter 2.

Fat

Although fat in food has received a bad name over the years, it is actually an essential nutrient. Fat is part of each cell membrane, and in the skin it helps form a barrier against water penetration. Fat is eaten as triglycerides, which consist of a molecule of glycerol bound to three molecules of fatty acids. The two fatty acids essential to life are linoleic acid and linolenic acid. These and other fatty acids can be made into a range of compounds called eicosanoids that control blood clotting, inflammation and immune function.

Fat is found in oils (100 per cent fat), butter and margarine (both about 80 per cent fat); it naturally occurs in oats, whole-grain cereals, nuts, peanut butter, seeds, eggs, avocado, milk, yogurt and cheese. Fat may be added during the manufacture of foods such as cakes, cookies, biscuits and snack foods; or it may be removed, such as in the production of non-fat milk or low-fat yogurt.

For many years there has been a constant message to eat less fat. 'Eat less fat' is an easy take-home message, whereas the more accurate 'Eat less saturated fat' was more difficult to market. Unfortunately, the 'eat less fat' campaigns have given the impression that all fat is bad. More recently we have heard the concept of 'good' and 'bad' fat. The truth has always been that we should be eating less of the 'bad' saturated fat because it causes atherosclerosis (fatty build-up in artery walls) and thrombosis (blood clots). Other types of fat, 'good' unsaturated fat, are unlikely to cause health problems. Table 1.3 shows the types of fat in foods.

Unfortunately, all types of fat eaten in excess are easily converted to body fat. The problem with people in many Western countries, and some athletes, is that they consume too much dietary fat and the excess gets converted to body fat. The more active people are, the less likely this is to happen. Don't see this advice as meaning that you should eat next to no fat because some nutritious foods contain a fair amount of 'healthy' fat, such as nuts and avocados. These foods provide many nutrients and antioxidant chemicals that protect you from disease. It would be crazy to eliminate these from your diet.

TABLE 1.3 Fat in Food

Mainly saturated fat	Mainly unsaturated fat
Cream, lard, copha	Monounsaturated and polyunsaturated margarine
Butter	Monounsaturated and polyunsaturated oil
Cooking margarine	Avocado
Commercial cakes, pastries, cookies and biscuits	Nuts
Fatty take-aways	Peanut butter
French fries, hot chips	Seeds
Hard cheeses, milk, yogurt	Tahini (sesame seed paste)
Fatty meats, salami, sausages	Oily fish
Snack foods, crisps	Lean meats

Types of Fat

Three main types of fat are found in food: saturated, monounsaturated and polyunsaturated. Another type of fat, called trans fat, also occurs naturally, although too much trans fat in processed fatty foods has been linked to a higher risk of heart disease. Fat is named after the dominant fat type. For example, olive oil is termed 'monounsaturated' because three quarters of its fat is monounsaturated. Let's take a look at each type of fat found in food.

- **Saturated.** Saturated fat is generally considered the 'bad' fat because of its link to heart disease and raising unhealthy blood cholesterol levels. The term *saturated* is an organic chemistry term meaning that each fatty acid is 'saturated' with the maximum number of hydrogen atoms. The term *saturated*, however, does not mean that the food is 'saturated with fat'. Foods high in saturated fat are listed in table 1.3 on page 7. Saturated fat is generally solid at room temperature and is often added to commercial cakes, biscuits, cookies, pastries and take-away foods. To be fair, some take-away franchises and food manufacturers are working hard to lower their saturated fat content and replace it with unsaturated fat.

- **Monounsaturated (MU).** This type of fat is viewed quite favourably in health terms and doesn't appear to contribute to future disease. Olive oil, canola oil and the avocado have put MU fat in the spotlight and spawned a range of MU margarines. Nuts, seeds and lean meat also provide some monounsaturated fat. In chemistry terms, *monounsaturated* means that one double bond (hence 'mono') exists between the carbon atoms in the fat, which entails dropping two hydrogen atoms; hence it becomes 'unsaturated' with hydrogen. This is not easy to comprehend unless you have a good knowledge of chemistry, which you will not need to understand the nutrition principles of this book.

- **Polyunsaturated (PU).** This type of fat is considered to be unrelated to poor health. Apart from PU margarines and oils, PU fat also appears in lean meat, nuts and seeds. The fats in oily fish are also PU, and are often referred to as omega-3 fats, fish oils or marine oils. The two most common types are EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid). You will see them listed in fish oil supplements. Fish and fish oil are associated with a lower risk of heart disease and stroke. Some people worry that heating PU fat converts it to saturated fat. Under normal domestic cooking conditions, no unsaturated fat gets converted to saturated fat. In chemistry terms, *polyunsaturated* means that two or more double bonds (hence 'poly', meaning more than one) exist between the carbon atoms in the fat, which results in some hydrogen atoms being dropped; hence it is 'unsaturated' with hydrogen.

- **Trans fatty acids (TFAs).** TFAs are naturally occurring in ruminant animals, so we find TFAs in beef, lamb, mutton, milk, cheese and yogurt. A TFA is technically an unsaturated fat, but it acts like a saturated fat and is linked to heart disease and heart attacks. Fortunately, the amount of TFAs we get from these foods is not a health problem. The production of margarine results in high TFA levels. Although this remains a problem in some countries such as the USA, other countries like Australia and New Zealand now have virtually eliminated TFAs from table margarine since the late 1990s. Check the margarine label because table margarine without TFAs is available in many countries. Hard margarines used in making pastries, cookies and biscuits (also called stick margarine or cooking margarine in supermarkets) are likely to contain TFAs.

How Much Fat Should You Eat?

You are often told that you should eat only 20 to 30 grams of fat a day. Good luck to you. Given that the average man eats more than 100 grams of fat every day, and the average woman, 70 grams of fat, it will take a monumental change and restriction in eating habits to make it down to 20 grams a day. A more realistic daily goal is 40 to 60 grams of fat for a moderately active adult.

Another common piece of advice given to the public is to avoid any individual food or food product that has more than 10 per cent fat by weight (10 g per 100 g). This means the deletion of avocados, olive oil, nuts, peanut butter, seeds, polyunsaturated margarine and good chocolate, none of which adversely affect the health of your heart or other parts of your body.

Any food that includes oats, chocolate, avocados, nuts or seeds will often have more than 10 per cent fat content; for example, muesli is commonly 10-12 per cent fat because of the oats and nuts present; peanut butter is 55 per cent fat. There is good evidence that these foods all have nutritional qualities that actually improve