Chapter 14

Nutrition and associated disorders

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Contents

Key words

- Proteins
- Anabolism
- Triglycerides
- Micronutrients
- Vitamins
- Fatty acids
- Glycogen
- Carbohydrates
- Lipids
- Macronutrients

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Test your prior knowledge

- What is malnourishment?
- What are micro and macronutrients?
- What is the body's main energy source?
- List the fat-soluble vitamins.

Learning outcomes

On completion of this section, the reader will be able to:

- Discuss the roles of carbohydrates, proteins and fats.
- Discuss the optimum dietary requirements for health.
- Describe the role of micro and macronutrients.
- List some of the nutritional assessment tools.

Don't forget to visit the companion website for this book (www.wiley.com/go/fundamentalsofappliedpathophysiology/student4e) where you can find self-assessment tests to check your progress, as well as lots of activities to practise your learning.

Introduction

Nutrition is vital for human existence. An adequate intake of nutrients is essential for the survival of the body's systems. Nutrients such as the proteins, carbohydrates, lipids and vitamins found in foodstuff are used by the body for energy production, growth and repair. The digestive organs (see Chapter 13) play a vital role in ingestion, absorption, transportation and elimination. When individuals do not receive sufficient nutrients, their body systems do not function efficiently.

This chapter discusses the roles of micro and macronutrients, identifies the different types of food sources and nutritional requirements of the body, and outlines government recommendations with regards to nutritional intake and nutritional disorders, such as obesity and underweight. Nutritional assessment tools and their importance in clinical practice will also be explored.

Healthcare professionals play a vital role in ensuring that the nutritional needs of the patient are met. In a community setting, support will be given to patients to help them make good food choices to optimise health and to effectively manage any chronic disease. In hospital, the key responsibilities of the healthcare professional include nutritional assessment of the patient on admission; managing mealtimes, e.g. providing privacy for the patient; ensuring that they are not disturbed during mealtimes and maintaining an accurate record of the patient's nutritional intake.

Nutrition is a fundamental aspect of maintaining health and preventing disease and yet forms a very small part of educational programmes for healthcare professionals. With diet-related disease soaring and placing a significant disease burden on our society, it is absolutely essential that health professionals are educated about nutrition, not only so that

patients receive as clear and consistent a message as possible about what to eat and what to avoid, but also to improve and maintain the health and well-being of the healthcare workforce. This chapter will offer some insight into this important topic.

Let food be thy medicine and medicine be thy food – Hippocrates

Macronutrients

Macronutrients are organic compounds required in relatively large quantities ('macro' means large) for normal physiological functions of the body. Macronutrients include:

- Carbohydrates
- Proteins
- Lipids

Red flag

There is a growing body of evidence indicating that a major imbalance in the relative proportions of macronutrients can increase risk of chronic disease and may adversely affect micronutrient intake.

Carbohydrates

Carbohydrates are organic compounds that contain carbon, hydrogen and oxygen molecules. They make up the body's main source of energy and are required in large quantities. Carbohydrates are found in a variety of whole foods including fruit, vegetables, whole grains (e.g. brown rice, oatmeal, quinoa, whole wheat breads and pasta), legumes (e.g. beans, peas, lentils), seeds and nuts. They are also found in foods less conducive to good health such as white flour, white rice and pasta, confectionary and a myriad of other processed foods. It is here that they gain their bad reputation for contributing to weight gain and ill health.

Carbohydrates are divided into two main groups:

1. Simple carbohydrates (sugars)
   a. Monosaccharides – e.g. glucose (found in fruit, sweet corn and honey) Fructose (fruit sugar), galactose (produced from lactose – sugar in milk),
   b. Disaccharides – e.g. sucrose (glucose and fructose), maltose (glucose) and lactose (glucose and galactose).

More recently, these sugars have been further subdivided; 'free sugars' is the term recommended to describe sugars which are not bound to the food's cellular structure. These may be naturally present, for example, in honey, syrup or unsweetened fruit juices or may be added to food by the cook, manufacturer or consumer, for example, in the form of bread, pastries, confectionary and sweetened beverages. Sugars that are bound to the cellular structure of the food, for example, whole fruits and vegetables, and the lactose contained in milk, fall outside of this definition (Scientific Advisory Committee on Nutrition, 2015, p. 182).

2. Complex carbohydrates
   a. Oligosaccharides, e.g. raffinose, stachyose, verbascose (found in beans, peas, bran and whole grains)
   b. Polysaccharides – e.g. glycogen (stored glucose), starch (e.g. potatoes, squash, rice, pasta), non-starch polysaccharides (dietary fibre).

Current UK guidelines recommend that 50% of the total calorie intake should be from carbohydrates, with no more than 5% from free sugars (BNF, 2019). A recent large-scale meta-analysis of research (Seidelmann *et al*., 2018) has indicated a U-shaped association between carbohydrate consumption and optimal health. Diets which take less than 47% or more than 70% of calories from carbohydrates are associated with a shorter life expectancy and greater incidence of ill health, with the optimum health benefits conferred at between 50% and 55% carbohydrates. However, the upper level of carbohydrate consumption (greater than 67%) was notably predominant in Asian populations and economically deprived areas, where consumption of higher quantities of carbohydrates from non-whole food sources, e.g. white rice, white bread and other processed foods, is prevalent (Dehghan *et al*., 2017). Evidence continues to emerge indicating that diets from predominantly whole plant food sources* (complex carbohydrates), are associated with lower rates of all-cause mortality, and this is considered to be in some part attributable to the higher consumption of dietary fibre found with whole food plant-based diets (Kim *et al*., 2018) in addition to a wider array of micronutrient availability in diets higher in fruit, vegetable and legume intake (Miller *et al*., 2017).

One gram of carbohydrate provides approximately 4 kcal/g of energy (British Nutrition Foundation (BNF) 2018a). Calories are units of energy found in food and drink. The body burns calories to produce energy, and any excess is stored as fat. In nutrition, values are given for the actual amount of kilocalories in food, but are commonly referred to in calories.

$$1000 \text{ calories} = 1\text{kcal}$$

Carbohydrates are broken down and converted into glucose by the digestive enzyme amylase found in the saliva and pancreas. Glucose is then oxidised to produce adenosine triphosphate (ATP), providing energy for immediate use by the cells. Glucose that is not required for immediate ATP production is then used for the formation of several amino acids, which are then incorporated into proteins. The remaining glucose may be converted to glycogen, stored in the liver and muscle cells or fat stored in adipose tissue (Tortora and Derrickson, 2017).

The body's capacity to maintain blood glucose levels is achieved by a variety of hormones; the two key hormones are insulin and glucagon. Both these hormones are produced by the pancreas and secreted into the bloodstream. Insulin secretion is increased after a meal has been eaten, and the main function of insulin is to transport glucose into the cells to produce ATP. In the absence of a carbohydrate meal and when the level of blood glucose is low, glucagon stimulates the liver to convert stored glycogen into glucose (a process called glycolysis). Thus, the important role of these hormones is to regulate blood glucose levels. Glucose can be made available by the liver from non-carbohydrate sources, such as proteins and fats, through a process called gluconeogenesis. However, it is important to remember that the body will always demonstrate a preference for taking its energy source directly from carbohydrates converted into glucose (Tortora and Derrickson, 2017).

Glycaemic index (GI) and control

When considering food for optimum health, food structure in addition to food composition is a key component (Wahlqvist, 2016). As discussed, carbohydrates have a significant impact on blood glucose levels, but spikes in these levels depend on how complex the structure of the carbohydrate is. Foods are measured on a scale of 0–100 in relation to their GI. The higher the number, the higher the GI and the quicker and more pronounced is the glucose spike. Simple carbohydrates containing 'free sugars' are quickly absorbed and will cause a sharp rise in blood glucose levels.

* A whole food plant-based diet aims to maximise consumption of nutrient-dense plant foods such as fruit, vegetables, whole grains, beans and pulses, and minimise processed foods, oils, meat, fish, dairy and eggs (Tuso *et al*., 2013).

These are referred to as high-GI foods. Complex carbohydrates take much longer to absorb and will cause a much slower and sustained rise in blood glucose; these foods are low GI.

The rate at which carbohydrates are digested is important for appetite control, for metabolism and for fat burning. Low-GI foods suppress appetite and can keep us feeling fuller for longer, ultimately reducing the amount of food consumed. High-GI foods lead to a slower resting metabolic rate, so fewer calories are burnt in the process of just existing, leading to weight gain. The regular surges in glucose stimulate insulin secretion, necessary for lowering blood glucose levels. Over time these 'spikes' and 'crashes' will take their toll, and cells become increasingly insulin resistant, leading to a gradual onset of type 2 diabetes. Thus, foods that are low GI, are generally unprocessed, whole grain foods high in fibre, and are important for weight control and managing type 2 diabetes (Waugh and Grant, 2018).

Proteins

Proteins are essential for growth and repair. They play a crucial role in virtually all biological processes in the body. All enzymes and many of the hormones are proteins and are vital for the body's function. Muscle contraction, immune protection and the transmission of nerve impulses are all dependent on proteins. Proteins found in the skin and bones provide structural support. The body uses carbohydrate and fat for energy, but when there is excess dietary protein or inadequate dietary fat and carbohydrate, protein is used to produce energy. Excess protein may also be converted to fat and stored in adipose tissue. Approximately 1 g of protein yields 4 kcal/g of energy (BNF, 2018b).

Proteins are highly complex molecules composed of amino acids. Amino acids are simple compounds containing carbon, hydrogen, oxygen, nitrogen, some sulphur and other elements such as phosphorus, iron and cobalt (Tortora and Derrickson, 2017). Amino acids are linked together by peptide bonds to produce new proteins in a process called 'protein anabolism'. There are 20 amino acids in all, and ten of these are known as 'essential amino acids'. These cannot be synthesised by the body and must be obtained from food sources. Different foods contain different proteins, each with their own unique amino acid composition.

Current UK guidance indicates that adults should consume between 10% and 15% of their total calorie intake as protein (with a maximum of 35%) (BNF, 2019). Commonly meat, fish, eggs and dairy products (milk, cheese and yoghurt) have been the major dietary sources of protein. However, with emerging evidence relating to the associations with consumption of these foods and poorer health (e.g. Song *et al*., 2016), protein from these sources should be limited to within the recommended guideline (Public Health England (PHE), 2016). Seeking protein from a variety of plant-based sources such as quinoa, legumes, soy products, whole grains, leafy greens, etc. is increasingly being recognised as a healthful way to provide adequate amounts of essential amino acids and prevent protein deficiency (Chalvon-Demersay *et al*., 2017; Richter *et al*., 2015)

Lipids

Lipid is a term generally used for fat-like substances. They contain carbon, hydrogen and oxygen and make up 18–25% of body mass in lean adults.

Triglycerides are the most plentiful source of natural lipids in the body and diet, accounting for approximately 97% of lipids overall and can be found in solid or liquid form as fat and oils, respectively:

- Saturated fat – A fat that contains mostly saturated fatty acids and becomes solid at room temperature. Occurs mostly in meat (especially red meat) and dairy (milk, cheese and butter) and plant sources such as cocoa butter, coconut oil, palm oil.
- Monounsaturated fat – Oil containing triglycerides consisting mostly of monounsaturated fatty acids. Found in plant foods such as nuts, seeds, olive oil, peanut oil, avocados.

- Polyunsaturated fat – Oil containing polyunsaturated fatty acids, e.g. sunflower oil, soybean oil, oily fish such as salmon, tuna and mackerel.
- Transunsaturated fat (commonly known as trans-fat) – Containing transunsaturated fatty acids, a particular type of polyunsaturated fat that can be made more saturated under high pressure through a process known as hydrogenation, turning the fat into solid form at room temperature. This type of fat is naturally found in small amounts in the gut bacteria of some animals, milk and meat but is more abundant (and harmful) in processed and convenient foods (Baic, 2007).

Lipids are essential for:

- Lubrication of food to facilitate swallowing
- Transportation of fat-soluble vitamins, such as vitamins A, D, E and K
- Synthesis of steroid hormones, such as testosterone and oestrogen
- Transportation of lipid-soluble drugs, such as nicotine and caffeine
- Biological membranes, such as cell and organelle membranes
- Energy production.

The simplest lipids are fatty acids. These are used in the synthesis of triglycerides and phospholipids, the major component of the cell membrane. From a nutritional perspective, the essential fatty acids (EFAs) are the most important and, as they cannot be made by the body, they must be included in our diets. The major EFAs are omega-3 and omega-6, which have opposing effects on metabolic functions in the body. Omega-6 is associated with inflammation and platelet aggregation, both essential functions to protect the body against acute infection and injury (Saini and Keum, 2018). However, over-consumption can lead to chronic inflammation and associated diseases including heart disease and cancer (Berquin et al., 2008). Conversely, omega-3 reduces inflammation and has a protective effect against cancer and heart disease (Adkins and Kelly, 2010; Gobbo *et al*., 2016). Omega-3 can be found in good supply in foods such as flaxseed, walnuts, fish oils and other oils that contain polyunsaturated fatty acids. Omega-6 is contained in most processed foods, eggs and meat.

Some digestion of fats into free fatty acids begins in the stomach with the aid of the digestive enzyme gastric lipase. The fat is mixed with other nutrients and is passed into the duodenum. Once the contents of the stomach reach the duodenum, the hormone cholecystokinin is released, which stimulates the release of bile from the gallbladder and pancreatic lipase (see Chapter 13). Fats are then further broken down and absorbed from the gastrointestinal tract.

Lipids are insoluble in water ('hydrophobic'), and so most lipids will be combined with proteins from the liver and intestine to be transported as units called lipoproteins (Figure 14.1). There are five types of lipoproteins:

1. Chylomicrons
2. Very low-density lipoproteins
3. Intermediate-density lipoproteins
4. Low-density lipoproteins – 50% cholesterol, 25% protein (often referred to as low-density lipoproteins (LDL) 'bad cholesterol')
5. High-density lipoproteins – 20% cholesterol, 40–45% protein.

Current UK guidance indicates that no more than 35% of calories should be consumed as fat, with a maximum of 11% of these from saturated and trans-fat sources due to their association with ill health (BNF, 2019). There is emerging evidence to support a decrease to the

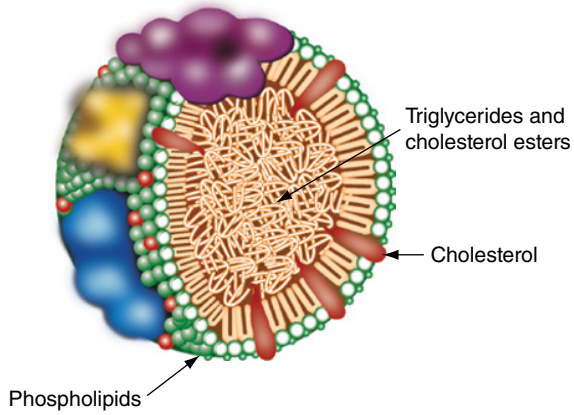

Figure 14.1 A lipoprotein.

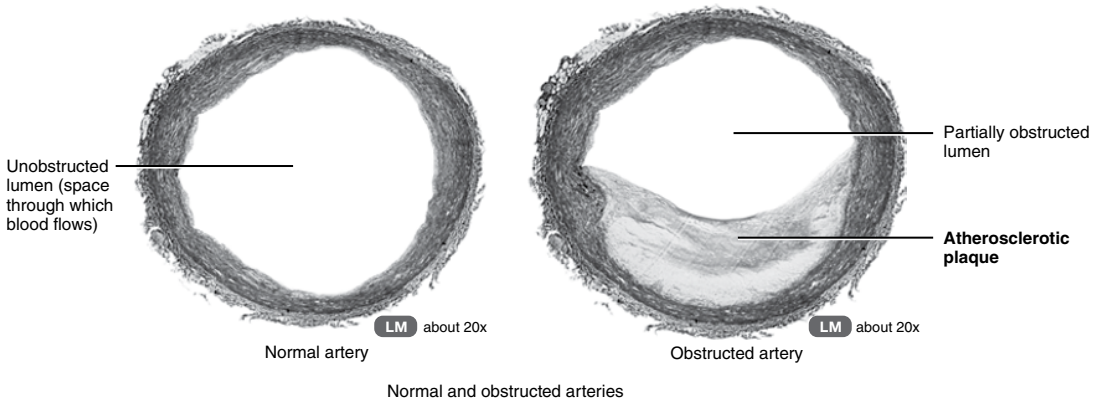

Figure 14.2 An example of plaque.

guidelines for the consumption of saturated and trans-fats further to a maximum of 6–7% of calories in the UK (in line with Japan) to reduce incidences of cardiovascular disease and all-cause mortality (NICE, 2020).

The major health issues associated with the consumption of these fats arise because of increased levels of LDLs. Normally, LDLs transport cholesterol from the liver to aid the body in repair and hormone production. However, where there is an excess, the LDLs accumulate in the artery walls where they interact with substances secreted from the endothelial and smooth muscle cells of the artery, gradually forming a 'plaque' commonly referred to as atherosclerosis, which narrows the path for the blood to flow (see Figure 14.2 for an example of atherosclerosis).

Through a complex interplay involving inflammatory processes and the formation of blood clots (Marzilli, 2012), coronary artery disease develops; the second leading cause of deaths in England and Wales (ONS, 2018). It is thought that these are the same mechanisms that also contribute to many of the other leading causes of death including Alzheimer's and dementia (Roher *et al*., 2011), cancer, stroke as well as chronic conditions such as diabetes and kidney disease, which all contribute to cardiovascular risk (NICE, 2016) and are modifiable through lifestyle changes and a balanced diet that is low in fat.

Red flag

Processed meat and cancer risk

The term 'processed' in relation to meat is defined as 'meat that has undergone treatment through salting, curing, fermentation, smoking or other processes to enhance flavour or improve preservation' (Turesky, 2018, p. 718).

While studies have shown that red and white meat contribute to all-cause mortality, the consumption of processed meat has a particular association with the development of cancer. This has been linked not only to the ingestion of fat and lipids but also cooking at high temperatures, which activates toxins such as nitrates that are present in such foods as link sausages, bacon, ham, cold cuts and hot dogs (Arash *et al*., 2017). These meats are now categorised along with tobacco in terms of their cancer risk (Bouvard *et al*., 2015) and ideally should be eliminated from our diets completely to optimise health.

Micronutrients

Micronutrients are organic compounds required in small quantities for the normal physiological functions of the body. They include chemical elements such as hydrogen, nitrogen and carbon, and minerals and vitamins, e.g. vitamins A, B group, C, D, E and K.

Vitamins

Vitamins are organic (carbon-based) substances essential for growth and cellular function. They are required in small quantities and are mainly absorbed from the diet and altered by the body. Some vitamins are synthesised by the body. There are two types of vitamins:

1. Fat-soluble
2. Water-soluble.

Vitamins A, D, E and K are fat-soluble vitamins, and they circulate in the bloodstream; any excess is stored in adipose tissue and used when the levels are low in the bloodstream. As these vitamins can be stored, it is not essential to take vitamins A, E and K daily in the diet.[†] In a healthy individual, fat-soluble vitamin supplements can lead to toxicity. Water-soluble vitamins B group and C circulate freely throughout the body and are not stored (except for vitamins B_{12} and B_6). Excess of these vitamins is excreted in the urine and not stored in the body. Toxicity from these vitamins is less likely and the individual will need a daily intake of these vitamins in the diet. Table 14.1 summarises the vitamins, the food sources containing them and their functions.

Minerals

Minerals form approximately 5% of body weight. Sodium, potassium and calcium form the positive ions (anions), while sulphur and phosphorus form the negative ions (cations).

Minerals are essential for:

- Strong bones and teeth
- Controlling body fluids between intracellular and extracellular fluid compartments
- Turning food into energy.

Table 14.2 summarises the minerals and their functions.

[†] Vitamin D appears to reduce the risk of influenza, and other respiratory tract infections such as COVID-19. Supplementation has been advised in the elderly, diabetic patients and the Black Asian and Minority Ethnic (BAME) community, where vitamin D deficiency is more common, to strengthen immune response, particularly during the winter months in the UK (Grant *et al*., 2020).

Table 14.1 Summary of vitamins and their functions.

	Food sources	Functions
Fat-soluble vitamins		
Vitamin A	In vegetables as carotenoids: carrots, spinach, kale, sweet potatoes, squash, mangoes In meat as retinol (liver), eggs, milk (including breast milk)	Good vision in dim light. Growth and immunity. Deficiency can lead to dry skin and hair, infections of ear, sinus, respiratory and urinary tract. Slow development of bones and teeth
Vitamin D	Synthesis by ultraviolet rays of the sun Some found in oily fish, eggs, fortified foods such as spreads and cereals	To maintain calcium levels Normal growth, bone and teeth formation. Deficiency can lead to rickets in children and osteomalacia in adults. Also associated with increased risk of respiratory tract infections such as influenza and COVID-19.
Vitamin E	Green vegetables, nuts, whole grains, plant oils, eggs	Antioxidant Maintains immune system
Vitamin K	Brussels sprouts, cabbage, kale, broccoli, spinach, spring onions, kiwi fruit, milk	Important in blood clotting
Water-soluble vitamins		
Vitamin B_1 (thiamine)	Pork, poultry peas, nuts, green beans, soybeans, lentils, rice, yeast, sunflower seeds and whole grains,	Essential for growth and carbohydrate metabolism
Vitamin B_2 (riboflavin)	Asparagus, avocados, beans and peas, mushrooms, sweet potatoes, whole grains, Brussels sprouts, spinach, kale, cabbage, fish, dairy products, eggs and meat	Involved in citric acid cycle
Vitamin B_3 (niacin)	Tuna, chicken and turkey peanuts, quinoa, muesli, yeast extract (marmite/vegemite), wild rice, whole wheat pasta, brown rice, peanuts, mushrooms, nutritional yeast	Involved in glycolysis. Deficiency can cause pellagra causing dermatitis, diarrhoea and psychological disturbances
Vitamin B_6 (pyridoxine)	Chickpeas, potatoes, bananas, turkey, salmon, tuna	Involved in amino acid metabolism, reducing depressive symptoms, anaemia, pre-menstrual syndrome, anxiety, depression, eye health
Biotin	Nuts, legumes, soybeans, green beans, tempeh, avocado, eggs	Synthesis of nucleic acid and fatty acid. Deficiency can lead to muscular pain, depression, dermatitis, fatigue and nausea
Vitamin B_5 (pantothenic acid)	Avocado, squash, mushrooms, baked potato, sweet potato, corn on the cob, mangetout peas, oranges, oatmeal, chestnuts, eggs, lean chicken, fish	Involved in glucose production from lipids and amino acids. Deficiency can cause muscle spasms, fatigue, insomnia and insufficient production of adrenal steroid hormones

(*Continued*)

Table 14.1 (Continued)

	Food sources	Functions
Fat-soluble vitamins		
Folate (folic acid)	Grain products, broccoli, Brussels sprouts, cabbage spinach and other leafy greens, peas, chick peas, legumes and liver (avoid in pregnancy), eggs.	Synthesis of nucleic acid. Deficiency in pregnant women can lead to higher risk of neural tube defects in infants
Vitamin B_{12}	Supplemented in meat, poultry, seafood and eggs. Fortified products such as plant-based milks and nutritional yeast. *Supplement essential in vegan diets*	Production of red blood cells. Deficiency can lead to pernicious anaemia and neuropsychiatric disorders such as memory loss, mood changes
Vitamin C (ascorbic acid)	Citrus fruits, tomatoes, potatoes, green and red peppers, berries, green leafy vegetables	Synthesis of collagen, important component of tendons, blood vessels and bone. Deficiency can lead to scurvy, anaemia, poor wound healing

Source: Adapted from Tortora and Derrickson, 2017.

Table 14.2 Minerals and their functions.

Minerals	Sources	Functions
Calcium (Ca^2)	Broccoli, tempeh, leafy greens, tofu, almonds, beans, lentils, oranges, seeds, dairy, sardines, calcium-fortified foods	For healthy teeth and bone formation, blood clotting, nerve conduction and muscle function
Iron (Fe)	Lentils, chickpeas, beans, tofu, cashew nuts, chia seeds, pumpkin seeds, kale, raisins, quinoa, meat	Production of red blood cells and energy production
Magnesium (Mg)	Nuts, legumes, tofu, seeds, whole grains, leafy greens, bananas, fish	Bone formation, muscle and nerve function
Phosphorus (P)	Poultry, pork, seafood, dairy, sunflower and pumpkin seeds, nuts, whole grains, quinoa, beans and lentils, soy	Teeth and bone formation
Potassium (K)	Bananas, apricots, raisins, dates, leafy greens, sweet potatoes, mushrooms, peas, cucumbers	Muscle and nerve function
Sodium (Na)	Table salt, clams, sunflower seeds, soy sauce, anchovies, *(Note: Sodium is added to a range of processed foods, and high sodium is linked to a variety of health issues. Intake to be limited)*	Nerve and muscle function; maintains osmotic pressure
Sulphur (S)	Meat and poultry, fish, seafood, eggs, dairy, peaches, apricots, sultanas, asparagus, broccoli, sprouts, red cabbage, leeks, onions, radishes	Components of hormones, vitamins and proteins, required for production of ATP
Zinc (Zn)	Legumes, seeds, nuts, dairy, eggs, whole grains, meat, dark chocolate	Essential for enzyme function, carbon dioxide transport and protein metabolism
Selenium (Se)	Brazil nuts, fish, meat, poultry, cheese, brown rice, beans, mushrooms, oatmeal, spinach, lentils, cashews	Antioxidant properties, required for immune function, synthesis of thyroid hormones, sperm motility. May also prevent certain birth defects, miscarriage and reduce prostate cancer and coronary artery disease

Source: Adapted from Tortora and Derrickson, 2017.

Eating to optimise health

Nutritional requirements vary according to health status, activity pattern and growth. For example, an elderly person's energy requirement is not the same as that of a pregnant woman, a baby or a young adult. During a growth spurt, there is more demand for energy. The energy demand also depends on the activity the individual is engaged in. An athlete who is in training will require more energy than a person who is not undertaking any activity, and a patient recovering from surgery or illness will need more energy during the period of recovery.

Dietary risk factors are ranked second only to tobacco in making a significant impact on the burden of disease in the UK (Steel *et al*., 2018). As morbidity and mortality continues to escalate, it is becoming increasingly evident that the standard UK diet, high in sugar, salt, saturated and trans-fats, is a major contributory factor. The messages around health and nutrition in the public arena can be conflicting and confusing. Given this, and the availability and convenience of processed and unhealthy foods, it is little wonder that diet-related disease is on the increase.

The WHO recommendations are to 'eat a nutritious diet based on a variety of sources originating mainly from plants, rather than animals' (WHO, 2018), and predominantly plant-based diets have been heralded in the literature as the nutritional equivalent to stopping smoking (Barnard, 2013). A recent large-scale, longitudinal meta-analysis (Zhong *et al*., 2020), found a significant association with eating processed and unprocessed red meat and poultry and an increased risk of cardiovascular disease and all-cause mortality. Consumption of dairy products including milk, cheese and yoghurt has also been associated with a number of health conditions including prostate cancer (Dagfinn, 2015) and more recently breast cancer (Fraser *et al*., 2020), with the fats and inflammatory markers present in dairy being thought to contribute to ill health overall.

Aside from the direct links highlighted above, there is a more indirect reason for the overconsumption of processed foods, meat and dairy to be contributing to a poor diet and that is the notable *omission* of the nutrients that are required for the maintenance of good health. Eating processed foods has been associated with a significant increase in salt, sugar and fat intake but also, importantly a significant reduction in the foods required for better health (Rauber *et al*., 2018). Put more simply, when our plates are crowded with bad food, we do not make room for the good food.

In summary of the evidence around healthful eating, the simplest and best (evidence-based) way to eat is:

- Eat the majority of your calories from predominantly plant-based sources as close to their natural form as possible (whole foods) e.g. vegetables, fruits, nuts, seeds, legumes and whole grains to ensure adequate intake of micro- and macronutrients.
- Avoid added salt, sugar and oil in food and drinks.
- Limit meat intake to a maximum of 70 g per day of lean meat, fish or poultry and avoid completely processed meats (e.g. bacon, sausage, beef cold cuts, ham).
- Incorporate 'meat-free' days into your weekly schedule to further reduce your intake of meat.
- Reduce dairy and egg intake and consume low fat dairy or plant-based alternatives as much as possible.
- Avoid alcohol.

See Figure 14.3 for the Eatwell Guide

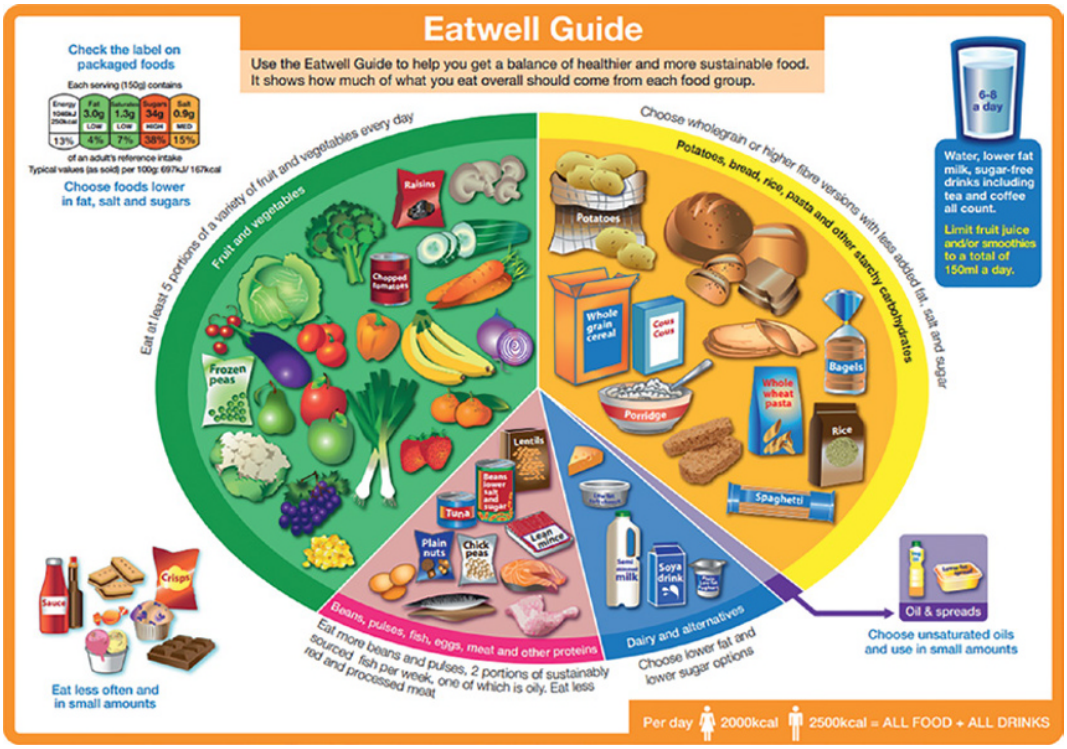

Figure 14.3 Food groups and recommended portions *Source:* PHE, 2016.

Red flag

Alcohol consumption

Moderate alcohol consumption is not *associated with reduced all-cause mortality (Goulden, 2015)*

It has been a generally agreed principle emerging from early evidence (Shaper *et al*., 1988) that light or moderate alcohol consumption reduces all-cause mortality. Health professionals have based their advice to patients on this guidance, recommending light to moderate alcohol intake as a protection against many health conditions. However, on further scrutiny of many of these studies, it was found that 'ex-drinkers' or 'very light drinkers' were being categorised as 'abstainers'. A significant number of people will reduce or stop alcohol when they experience ill health or take medication. This meant that there was more ill health in the 'abstainer' groups, but when these errors are corrected, there is a direct linear association between alcohol consumption and increased risk of disease (Goulden *et al*., 2015; Chikritzhs *et al*., 2015). In short, the more the alcohol consumed, the greater the risks to health, and alcohol consumption should be at a maximum to within government guidance (14 units per week) with maximum health benefits conferred at zero units!

Nutritional disorders

Learning outcomes

On completion of this section, the reader will be able to:

- List some of the common disorders of nutrition.
- Describe the pathophysiological processes related to nutritional disorders.
- List the possible investigations.
- Outline the care and interventions related to the disorders described.

Snapshot Weight gain

Solomon is a 40-year-old man who lives with his wife Rachel and their two children. Solomon is 172 cm tall and weighs 100 kg, and Rachel is 160 cm tall weighing 88 kg. Solomon and Rachel run a small online business, working from home. Solomon tells you, 'Rachel and I have struggled with our weight for years. I can see that the children are gaining weight, too. We both work long hours sitting at our desks and it is hard to find time to cook. We live mostly on fast food like Chinese and Indian takeaways, kebabs and pizzas'. Solomon went to see his GP because lately he noticed that he had frequent headaches and suffered from dizziness and fatigue. After several tests, his GP informed him that he is hypertensive and that he should consider antihypertensive medication. The GP also informed him that he is overweight and that he should see the practice nurse to get some dietary advice.

Vital signs

The practice nurse noted and recorded the following vital signs were:

Vital sign	Observation	Normal
Temperature	36.2°C	36.0–37.9°C range
Pulse	88 beats per minute	60–100 beats per minute
Respiration	19 breaths per minute	12–20 breaths per minute
Blood pressure	180/115 mmHg	100–139 mmHg (systolic) range
O_2 saturation	98%	94–98%

A full blood count and urea and electrolytes was carried out.

Test	Result	Guideline normal values
White blood cells (WBC)	12×10^9/L	4 to 11×10^9/L
Neutrophils	6.5×10^9/L	2.0 to 7.5×10^9/L
Lymphocytes	2.9×10^9/L	1.3 to 4.0×10^9/L
Red blood cells (RBC)	6.3×10^{12}/L	4.5 to 6.5×10^{12}/L
Haemoglobin (Hb)	160 g/L	130–180 g/L
Platelets	298×10^9/L	150 to 440×10^9/L
C-reactive protein	4.2 mg/L	<5 mg/L
Urea	6.6 mmol/L	2–6.6 mmol/L
Potassium	5.1 mmol/L	3.4–5.6 mmol/L
Sodium	138 mmol/L	135–147 mmol/L

Take some time to reflect on this case and then consider the following:

1. Calculate the body mass index (BMI) for Solomon and Rachel.
2. Discuss the possible complications of obesity.
3. Outline a plan of care for Rachel and Solomon with regard to losing weight.
4. What support systems are available in the community for this family?

Malnutrition

NICE (2012) defines malnutrition as a '. . . state in which deficiency of nutrients such as energy, protein, vitamins and minerals causes measurable adverse effects on body composition, function or clinical outcome'.

Malnutrition includes undernutrition (wasting, stunting and underweight), inadequate vitamins or mineral intake, overweight and obesity. As discussed above, unhealthy diets and poor nutrition lead to a variety of diet-related non-communicable diseases (e.g. heart attacks, stroke, cancer and diabetes) and contribute to the leading causes of death globally (WHO, 2020). We will now consider how health professionals can effectively care for adults who are suffering because of obesity or being underweight.

Obesity

When we talk about malnutrition we most frequently think of those who are extremely underweight. However, obesity is increasingly being recognised as a disease of malnutrition as although food is consumed in large quantities, the diet may be high in fat and sugar and low in essential vitamins and minerals, causing disease (WHO, 2020).

Obesity is an excessive accumulation of fat cells (adipose tissue) for an individual's height, weight, gender and ethnicity, to such an extent that it can lead to health problems. The fat may settle in the abdominal region (apple-shaped), hips or thighs (pear-shaped). One useful tool for calculating obesity is body mass index (BMI). The formula for BMI is:

$$\text{BMI} = \frac{\text{weight}(\text{kg})}{\text{height}(\text{m})^2}$$

An individual with a BMI between 19 and 24.9 kg/m^2 is of normal weight, of 25–29.9 kg/m^2 is considered overweight and of over 30 kg/m^2 is considered obese. Obesity can reduce life expectancy and lead to complications:

- Heart disease
- Diabetes mellitus
- Vascular disease
- Respiratory disease
- Hypertension
- Bowel cancer
- Deep vein thrombosis
- Varicose veins
- Cerebrovascular accident.

Red flag

The prevalence of obesity and overweight is increasing around the world, but the rates in the UK are among the highest in Europe (OECD, 2017).

Globally, over 4 million people per year die as a result of being obese (Steel *et al*., 2018), with the UK being in the top 50% of countries with a high BMI with 1 out of every 4 adults classed as obese (NHS, 2019). Public health initiatives raising awareness of the importance of a healthy diet (e.g. PHE, 2016) have had negligible impact, with a notable increase in the prevalence of obesity since 2007 (PHE, 2020). The healthy eating message seems to be slow to translate into a reduction in obesity and sub-optimal nutrition, hitting those living within deprived areas from lower socio-economic backgrounds hardest (PHE, 2020). This places a significant burden on the NHS – direct costs caused by obesity are estimated to be £6.1 billion per year and are forecast to reach £9.7 billion by 2050 (PHE, 2017).

Aetiology

Both hereditary and environmental factors have been associated with obesity, including physiological, psychological and cultural influences. Some of the causes include the following:

Lifestyle factors:

- Diet high in sugar and fat
- Portion size
- Physical inactivity

Social and psychological factors:

- Habits of family and friends
- Low socio-economic status
- Less formal education
- Low self-esteem
- Depression
- Previous psychological trauma (e.g. abuse in childhood)

Physical factors:

- Genetics (may impact how we metabolise food or how we store excess calories)
- Medical conditions (e.g. Polycystic ovary syndrome, hypothyroidism)

- Medications (e.g. beta-blockers, lithium, anti-psychotics, steroids)
- Age (obesity rates increase with advancing age)
- Peri- and menopause

(*Source*: NICE, 2017a)

Orange flag

To increase muscle strength and power beyond the natural limit, some people turn to substances like anabolic-androgenic steroids. Anabolic refers to growth promotion, whereas androgenic refers to the development of male sex characteristics. While steroids' muscle-building capabilities are well documented, they come with several potential side effects. Steroid use has been associated with increased aggression and impulsivity, particularly in male teenagers and adults as well as depression, mood swings and mania.

Signs and symptoms

Most practitioners use the BMI assessment tool to identify if a person is overweight or obese:

- BMI between 25 and 29.9 kg/m^2 is overweight
- BMI between 30 and 39.9 kg/m^2 is obese
- BMI over 40 kg/m^2 is extremely obese
- Visible body fat accumulation on hips, waist and thighs
- Increased abdominal girth
- Increased weight
- Waist–hip ratio.

Screening tools for nutritional assessment

The following tools may be used to determine the level of obesity:

- BMI to identify excess adipose tissue, but this needs to be interpreted with caution as it is not a direct measure of adiposity (NICE, 2014).
- Malnutrition Universal Screening Tool (MUST) to determine nutritional status (Malnutrition Advisory Group, 2003).
- Anthropometry measurements to measure skinfold thickness.
- Clinical assessment of the patient.
- Biochemical tests to assess nutrient levels, e.g. protein, HBA1c (to assess for Type 2 diabetes) and lipid profile (NICE, 2014).

Clinical investigations

MUST Tool

The Malnutrition Universal Screening Tool (MUST) was developed by the Malnutrition Advisory Group, a standing committee of British Association for Parenteral and Enteral Nutrition (BAPEN). It has been validated for use in hospitals and the community, and it is the tool recommended by NICE (2014), with its key benefits noted as being quick and easy to use in a variety of care settings. Its use is supported by the British Dietetic Association (BDA), the Royal College of Nursing (RCN) and the Registered Nursing Home Association (RNHA), and it is the most commonly used nutritional screening tool in the UK.

Care and management

In addition to the wide-ranging physical morbidities associated with obesity, patients who are overweight or obese may also suffer from mental health issues such as depression and low self-esteem. These may cause the person to overeat (comfort/emotional eating) or may be as a result of associated social stigma, self-blame or physical constraints such as reduced mobility. Healthcare professionals will need to be sensitive to the patient's feelings when working with these patients and should support the patient to identify the cause of obesity, offering advice on preventative measures, such as dieting and exercise, ensuring that wider determinants such as age, ethnicity and gender are factored in to any package of support.

Advice on diet and healthy eating (Figure 14.2) should be offered as recommended by the Department of Health (PHE, 2016) and outlined in the "Eating to optimise health" section above. The patient should be encouraged to have their weight checked weekly and to keep a record of this.

The patient should be encouraged to take regular exercise for weight reduction unless contraindicated. The British Nutrition Foundation Task Force (2015) recommends 30 minutes of exercise, such as walking, cycling or swimming, at least five times per week, but encouraging the individual to do exercise that they enjoy is more likely to produce positive results. The level of activity should be gradually increased to the level they can tolerate.

Pharmacological interventions

The use of medication has been questioned as an effective weight loss strategy. Studies have shown that weight loss does not generally exceed 4 kg where prescription medications are taken (Haddock *et al*., 2002) and, given the additional side effects, as well as weight gain as soon as patients discontinue taking them, (Rodríguez and Campbell, 2016), they should be used with caution.

Orlistat is the only drug currently available in the UK that is recommended specifically for the treatment of obesity. It is not recommended for all obese patients and should only be prescribed for those with a BMI greater than 30 kg/m^2 or above after careful assessment of co-morbidities (NICE, 2014).

Medicines management

Orlistat

Orlistat is a lipase inhibitor for obesity management that acts by inhibiting the absorption of dietary fats. Orlistat inhibits dietary fat absorption by approximately 30%. It works by inhibiting pancreatic lipase, an enzyme that breaks down fat in the intestine. Without this enzyme, fat from the diet is excreted undigested, and not absorbed by the body. However, some vitamins are fat soluble, and Orlistat will reduce their absorption. As undigested triglycerides are not absorbed, the resulting caloric deficit may have a positive effect on weight control.

Some common side effects include:

- Bladder pain/discomfort
- Body aches
- Chills
- Cough
- Diarrhoea
- Difficulty with breathing
- Fever

- General feeling of discomfort or illness
- Headache
- Loss of appetite.

Less common side effects include:

- Tightness in the chest
- Tooth or gum problems
- Troubled breathing
- Wheezing.

Surgery

Surgery may be offered to some patients when dieting and exercise have not been successful in reducing their weight. Surgical procedures such as gastric bypass (Roux-en-Y connection) may be carried out to limit the quantity of food the individual can eat at any one time (Figure 14.4). A large-scale systematic review of bariatric treatments indicates that gastric bypass may be more effective than other surgeries for weight loss but does carry greater risk of complications (Panagiotou *et al*., 2018). Many of the benefits of weight loss surgery may be associated with the necessary caloric restriction before and after surgery (Pop *et al*., 2018), which brings into question whether other means of caloric restriction would be of greater benefit in this group of patients.

Snapshot – weight loss

Miss Fuji Mata is a 79-year-old woman who lives alone. Her neighbour, Afzal, has been visiting Fuji and helping her with shopping. He notices that Fuji has lost quite a bit of weight recently and is looking drawn and pale. She also seems to be confused at times. When he unpacks her shopping, he is throwing away much of what he bought for Fuji previously and is concerned that she is not eating. He speaks to Fuji, who reports a loss of appetite and says she 'cannot be bothered' to cook for herself. Sometimes she will have a bowl of cereal and a few cups of tea in a day, and that is all she wants. Afzal asks Fuji if he can contact her GP and she agrees. Following a telephone consultation with the GP, she asks the community nurse team to visit Fuji at home.

Vital signs

The community nurse records the following vital signs:

Vital sign	Observation	Normal
Temperature	36.8°C	36.0–37.9°C range
Pulse	58 beats per minute (irregular)	60–100 beats per minute
Respiration	18 breaths per minute	12–20 breaths per minute
Blood pressure	90/60 mmHg	100–139 mmHg (systolic) range
O_2 saturation	98%	94–98%

A full blood count and urea and electrolytes was performed.

Test	Result	Guideline normal values
White blood cells (WBC)	8.5×10^9/L	4 to 11×10^9/L
Neutrophils	6.6×10^9/L	2.0 to 7.5×10^9/L
Lymphocytes	3.9×10^9/L	1.3 to 4.0×10^9/L
Red blood cells (RBC)	4.5×10^{12}/L	4.5 to 6.5×10^{12}/L
Haemoglobin (Hb)	98 g/L	130–180 g/L
Platelets	198×10^9/L	150 to 440×10^9/L
C-reactive protein	4.8 mg/L	<5 mg/L
Urea	6.5 mmol/L	2–6.6 mmol/L
Potassium	3.5 mmol/L	3.4–5.6 mmol/L
Sodium	138 mmol/L	135–147 mmol/L

Take some time to reflect on this case and then consider the following:

1. Discuss the effects of undernutrition on the systems of the body.
2. Explain what key factors are leading to Fuji's weight loss.
3. Outline a plan of care for Miss Mata's malnutrition.
4. With the aid of a risk assessment tool, what nutritional advice will you offer Miss Mata?

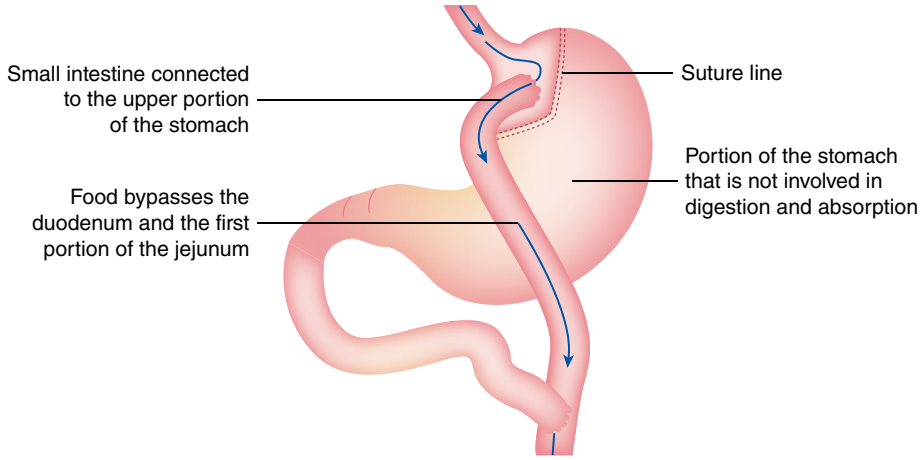

Figure 14.4 Gastric bypass surgery.

Malnutrition and underweight adults

Malnourishment leading to being underweight can be detrimental to health, and if untreated, can result in complications. Malnourishment is most likely to develop in the community setting, and it is reported that malnourished patients visit their GPs more often, when in hospital have longer stays and are more likely to develop complications or infections. Multisystem failure and death can occur from severe weight loss as a result of malnourishment.

Carbohydrates and fats are the main energy source of the body. When dietary intake is not sufficient to meet the energy requirements of the body, stored glycogen, body protein and fats are used to produce energy (Tortora and Derrickson, 2017). In a severe state of malnourishment in underweight people, the body uses its fat reserve and converts it into fatty acid and ketones, which provide energy for the brain. As the disease process progresses, body mass is reduced, and there is a reduction in energy expenditure.

Signs and symptoms

- BMI between 17 and 18.5 kg/m^2 – mild malnourishment
- BMI between 16 and 17 kg/m^2 – moderate malnourishment
- BMI less than 16 kg/m^2 – severe malnutrition
- Severe muscle wasting
- Wrinkled skin in patients with marasmus
- Distended abdomen in patients with kwashiorkor
- Swollen ankles in patients with kwashiorkor.

Aetiology

Causes of malnutrition include:

- Elderly and living on their own
- Eating disorders (e.g. anorexia nervosa, bulimia)
- Medical conditions e.g. cachexia, osteo- and rheumatoid arthritis
- Neuro-degenerative disease e.g. dementia, Alzheimer's
- Socio-economic factors, e.g. poverty, isolation
- Unconscious patients
- Chronic disease such as cardiovascular and renal disease
- Ill-fitting dentures and periodontal disease
- Stomatitis or candida
- Loss of appetite, e.g. as a result of chemotherapy or excessive alcohol consumption or other substance abuse.

Screening tools

- Clinical assessment of the patient
- MUST to determine nutritional status (Malnutrition Advisory Group, 2003)
- BMI
- Anthropometry measurements.

Care and management

Prior to planning care, a full assessment of the patient should be undertaken, including a physical assessment, nutritional assessment, past nursing and medical history, and any problems the patient may present with that could result in undernutrition. Assessment may reveal:

- Changes in dietary habit
- Physiological problems such as swallowing difficulties that may have an effect on nutritional intake
- Poor mental health, e.g. depression, anxiety, dementia
- Socio-economic factors such as lack of finance that may affect purchasing and cooking of food
- Cultural and religious beliefs.

The multidisciplinary team will work with the patient to develop a plan to address the underlying issues and begin to improve and increase their nutritional intake. The plan may include measures such as the completion of a daily food diary and daily weight checking. It is essential that a holistic approach to the care plan is offered, factoring in advice on the best food to purchase that is also in line with patient's preferences, values and religious or cultural requirements.

Where oral supplements (e.g. Ensure Plus) are required, the dietician will be able to give advice on the appropriate supplement for the patient to take in accordance with the NICE (2017b) recommendations and guidelines on nutritional support in adults.

It is also essential that advice is given regarding adequate fluid intake to prevent dehydration, and a fluid balance chart may be commenced to monitor fluid intake and output depending on their condition. The patient should be encouraged to take at least 180 mL of water every hour to prevent dehydration and infection. Any significant changes in fluid balance should be reported immediately to allow prompt action to be taken, e.g. commencement of an intravenous infusion if the patient is dehydrated. Conversely, excessive fluid overload can result in heart or kidney failure.

Any food offered, particularly within a hospital setting, should be as healthy and nutritious as possible and should look appetising. An overview of hospital food standards in 2014 led to a report outlining best practice for the provision of food in hospitals. The report was keen to emphasise an approach whereby the MDT use the term 'eating for health' as a way to describe a diet that is tailored to the individual's therapeutic requirements as 'healthy eating' may be mistaken for calorie restriction (DH, 2014). This includes the consideration of portion size as well as protected mealtimes to ensure patients are given privacy and are appropriately assisted as required. It is the role of the healthcare professional to ensure that the nutritional needs of the patient are met, and this is a key component of the Health and Social Care Act (2008 reg 14: 2014)

Orange flag

Being underweight, whether or not weight is lost intentionally, results from a variety of factors, some psychological, some physiological. A major psychological cause of underweight is depression. Those who experience depression may present with a reduced appetite and rapid weight loss; in these instances, advice from a psychologist or counsellor should be obtained in addition to guidance from a dietician.

Clinical investigations

Malnutrition assessment

Screening should assess BMI and percentage of unintentional weight loss, and consider the timescale of reduced nutritional intake and the likelihood of this continuing in future. Several screening tools exist to aid this assessment, including:

The Malnutrition Universal Screening Tool (MUST), which was developed by the Malnutrition Advisory Group, a standing committee of BAPEN.

The Mini Nutritional Assessment short-form (MNA-SF), which is a practical tool for identification of nutritional status.

Nutritional support should be considered for those:

- With a BMI <18.5.
- With unintentional weight loss of >10% over the previous 3–6 months.

- With a BMI <20 and unintentional weight loss of >5% over the previous 3–6 months.
- Those who have eaten little or nothing for >5 days and who are unlikely not to for the following 5 days or longer.
- For those who have poor absorption, high nutrient losses or increased nutritional needs.

Enteral nutrition

To facilitate enteral nutrition, a tube is inserted directly into the gastrointestinal tract, and the patient is fed a liquid diet through the tube. Enteral feeding is used to supplement oral intake or if the patient is unable to take nutrition orally. Indications include (British Association for Parenteral and Enteral Nutrition (BAPEN), 2018):

- Strokes or other neurological conditions that may impair swallowing
- Surgery of face, neck, gullet or stomach
- Blockages of gullet or stomach
- Radiotherapy of gullet or stomach

Types of enteral feeding include:

- Nasogastric (NG) tube feeding involves the insertion of a nasogastric tube via the nasopharynx into the stomach. This procedure is normally carried out by a registered nurse or medical staff.
- Nasojejunal (NJ) tube feeding involves the insertion of a tube via the nasopharynx and the stomach into the jejunum. Insertion of the NJ tube is carried out by medical staff using endoscopy, and it is confirmed to be in place radiologically.
- Percutaneous endoscopic gastrostomy (PEG) or jejunostomy (PEJ) involves the insertion of a tube into the stomach through the abdominal wall. This procedure is carried out surgically by the medical staff.

Care and management of the patient with enteral feeding

Healthcare professionals should support patients with decisions regarding enteral feeding where patients have capacity. Where the patient consents, family members may also be included in discussions and decisions regarding the commencement of enteral feeding (NICE, 2017). Nursing care involves the frequent monitoring for complications, e.g. breathlessness, abdominal distension and recording of vital signs every 2 hours. They should ensure that the enteral feeding tube is correctly positioned before commencing each feed. Local policies, guidelines and the NICE (2017) recommendations in the management and care of the patient with enteral feeding should be adhered to.

Healthcare professionals need to ensure that the patient who is receiving an enteral feed has full care, such as oral and nasal hygiene, washing hands before administering the feed and documenting all the care given as per local policy and procedure and in alignment with the Nursing and Midwifery Council Code (2018).

Red flag

Prior to commencing nasogastric feeding, a range of tests must be performed to confirm that the tube is in the stomach and not the lungs. Local policy and procedure must be adhered to.

Parenteral nutrition

Parenteral nutrition is the direct infusion of a solution into a vein and is used when the patient cannot be nourished with oral or enteral feeding. The solution contains all essential nutritional requirements (micro- and macronutrients) for the body, including fluid replacement. It is a specialised method of feeding which requires specialist care from healthcare professionals. The patient receiving parenteral nutrition in the community will need coordinated support from the district nurse, specialist nutrition nurse, dietician, pharmacist and GP (NICE, 2017b). The patient receiving parenteral nutrition is at risk of developing complications such as infection, fluid overload, heart failure, electrolyte imbalance and respiratory and renal complications. It is not the remit of this chapter to describe this specialist care. Further in-depth discussion regarding the special care of patients receiving parenteral nutrition can be found elsewhere, e.g. Dougherty and Lister (2015).

Conclusion

Nutrition plays a vital role in body function and maintaining homeostasis. Nutrients are classified as micro- and macronutrients. The macronutrients include carbohydrates, proteins and fats, while micronutrients are vitamins and minerals. These nutrients are primarily obtained from the diet and are absorbed from the gastrointestinal tract after digestion. Macronutrients are primarily for energy production, whilst micronutrients promote growth, immunity and development.

Malnutrition leading to obesity and underweight are two major global and national concerns contributing to a significant disease burden and incurring ever-increasing costs to the health and social care sector. The causes of obesity are multi-factorial, associated with lifestyle, social factors as well as physical and mental health disorders. It is a growing issue that is becoming increasingly stigmatised in society. Underweight is becoming increasingly prevalent as the elderly population is increasing. Some elderly people and children are more prone to malnourishment and being underweight as a result of illness or socio-economic factors.

The role of the healthcare professional is varied as regards nutritional care. The responsibilities include preventing malnutrition in patients and offering health education and support relating to obesity and underweight. It is their responsibility to prevent and highlight nutritional problems and to take prompt action to prevent complications, such as heart failure, renal disease, constipation and even death.

Test your knowledge

1. Explain the roles of carbohydrates, protein and fats.
2. Explain the terms micro- and macronutrients.
3. List the fat-soluble vitamins and describe their functions.
4. List the possible causes of obesity and underweight.
5. How are lipids transported in the body?

Activities

Here are some activities and exercises to help test your learning. For the answers to these exercises, as well as further self-testing activities, visit our website at **www.wiley.com/go/fundamentalsofappliedpathophysiology/student4e**

Multiple choice questions

1. Which of the following are simple carbohydrates?
   (a) Oligosaccharides
   (b) Polysaccharides
   (c) Monosaccharides
2. Which of the following foods contain complex carbohydrates?
   (a) Bread
   (b) Cola
   (c) Sweet potatoes
3. What is the current UK recommended intake of total carbohydrates?
   (a) Less than 47%
   (b) 50%–55%
   (c) More than 70%
4. What is the body's preferred energy source?
   (a) Glucose
   (b) Protein
   (c) Ketones
5. What is the process of the production of new proteins called?
   (a) Protein metabolism
   (b) Protein anabolism
   (c) Protein synthesis
6. How many essential amino acids are there?
   (a) 10
   (b) 20
   (c) 40
7. Which of the following foods does *not* contain saturated fat?
   (a) Beef
   (b) Cheese
   (c) Bananas
8. Which of the following foods contain transunsaturated (trans) fat (tick all that apply)?
   (a) Meat
   (b) Milk
   (c) Fish and chip takeaway
9. What does the UK guidance state that the maximum percentage of calories from total fat sources should be?
   (a) 50%
   (b) 35%
   (c) 10%
10. Which of the following vitamins is fat soluble?
    (a) Vitamin C
    (b) Vitamin B
    (c) Vitamin K
11. Which of the following foods contain omega-3 fatty acids?
    (a) Flaxseed
    (b) Lean beef
    (c) Oranges

12. What is the major source of Vitamin D?
    (a) Bananas
    (b) Yellow peppers
    (c) Sunlight
13. Which of the following foods are classed as "legumes" (tick all that apply)?
    (a) Nuts
    (b) Beans
    (c) Lentils
14. How frequently should observations be undertaken on patients receiving enteral nutrition via a nasogastric tube?
    (a) Every 24 hours
    (b) Every 4 hours
    (c) Every 2 hours
15. How many alcohol units is it safest to drink for general health for both men and women?
    (a) 14
    (b) 0
    (c) 28

Conditions

The following is a list of conditions that are associated with nutrition and associated disorders. Take some time and write notes about each of the conditions. You may make the notes taken from textbooks or other resources (e.g. people you work with in a clinical area), or you may make the notes based on people you have cared for. If you are making notes about people you have cared for, you must ensure that you adhere to the rules of confidentiality.

Scurvy	
Hypervitaminosis A	
Rickets	
Constipation	

Anorexia nervosa	

Further resources

Nutrition Facts

https://nutritionfacts.org/ Here you can access a range of evidence-based videos, podcasts and a variety of other resources and peer-reviewed publications all relating to a healthy diet. This is a non-profit, and the founder, Dr Michael Gregor, has written a number of books that are also worth reading including *How Not To Die* and *How Not To Diet*.

Department of Health (DH)

Public Health England (2018). 'Quick Guide to the Government's Healthy Eating Recommendations' can be found here and offer a user-friendly overview of the Eatwell Plate: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/742746/A_quick_guide_to_govt_healthy_eating_update.pdf Accessed 14 June 2020.

National Institute for Health and Care Excellence (NICE) – Obesity

http://guidance.nice.org.uk/CG43/Guidance Accessed 3 October 2015.

There is increasing recognition both in the UK and worldwide that there is an 'obesity epidemic'. The issue has received much attention recently from politicians, professionals, the media and the public.

This link gives some insight into a whole range of guidelines from NICE with regards to obesity.

World Health Organization (WHO)

http://www.who.int/topics/nutrition_disorders/en/ Accessed 14th June 2020.

Nutritional disorder is not just a UK problem. It is a worldwide issue. Some of the conditions discussed in this chapter, such as obesity and undernutrition, can lead to other physiological problems, both in adults and in children. WHO provides guidance and recommendations with regards to these health issues. All students should access this website to gain knowledge on these issues.

National Institute for Health and Care Excellence (NICE) – Eating disorders

https://www.nice.org.uk/guidance/ng69 accessed June 2020

In this NICE guidance, you will find information on anorexia nervosa, bulimia nervosa and related eating disorders.

British Medical Journal

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1118795/ Accessed 3 August 2016.

Students may find this link beneficial as there are numerous articles related to eating disorders and the burden these impose on finance and resources.

Glossary of terms

Anthropometry Assessment tool used to measure skinfolds.

Body mass index A number calculated from a person's weight and height.

Buffer A chemical substance that allows a slight change in pH when acid or base is added to the solution.

Carbohydrate An organic compound that is composed of carbon, hydrogen and oxygen. Sugars (including glucose) and starch are carbohydrates. They are very important as an energy store.

Coenzyme A molecule that binds to an enzyme and is essential for its activity, but is not permanently altered by the reaction.
Dysphagia Difficulty in swallowing.
Enteral Through the gastrointestinal tract.
Extracellular Outside the cell.
Fatty acid Composed of carbon chemically bonded together.
Fistula An abnormal passage from an internal organ to the surface of the skin or between two organs.
Gastrectomy Surgical excision of part or the whole of the stomach.
Glucagon A hormone released by the pancreas, which increase blood sugar levels.
Gluconeogenesis The production of glucose from non-carbohydrate sources.
Glycogen A carbohydrate (complex sugar) made from glucose. Excess glucose is stored as glycogen mainly in the liver.
Glycogenolysis The conversion of glycogen into glucose.
Intracellular Inside the cell.
Ketone Product of fat metabolism.
Kwashiorkor Protein-deficiency malnutrition.
Lipid An energy-rich organic compound that is soluble in organic substances such as alcohol and benzene.
Lipoprotein A transport unit for lipids with proteins.
Macronutrient A nutrient that provides energy.
Marasmus Protein- and carbohydrate-deficiency malnutrition.
Micronutrient Vitamins or mineral.
Nutrient Chemical component of foods.
Obesity Excess of body fat.
Organelle A structural and functional part of a cell that acts like a human organ to fulfil all the needs of the cell so that it can grow, reproduce and carry out its functions.
Protein An organic nitrogenous compound essential as the building material for growth and repair.
Synthesis Production.
Triglyceride A major form of lipids in the body.
Undernutrition Failing health as a result of inadequate nutrient.
Vitamin An organic compound essential for physiological functions of the body.

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