Nutrition

Mike Murray looks at one of the new topics for the 2008 AQA specification for physical education.

The specification lists the content to be covered as follows:

Nutrition

- the seven classes of food and their exercise-related function — fats, proteins, carbohydrates, vitamins, fibre, minerals and water
- the need for a balanced diet and the energy balance of food
- the performer's use of nutritional information based on their activity, difference in diet composition between endurance athletes and power athletes
- definitions of obesity and the limitations in trying to define it
- percentage body fat/body composition and body mass index (BMI) as measures of nutritional suitability

Summarising, we can see that candidates need to understand the exercise-related functions of the seven classes of food; the concept of a balanced diet and the different types of food intake that different athletes might require; and the energy balance of food, especially in respect of over-consumption and obesity.

Seven classes of food

The functions of carbohydrates and fats as energy sources and proteins for growth and repair are simply extensions of GCSE physical education and science. For AS, additional information concerning the different locations and uses of the carbohydrates glucose and glycogen and the triglycerides and fatty acids may be required (see Table 1).

Table 1

	Transported form (in the blood)	Storage form (in muscle)
Carbohydrates	Glucose	Glycogen
Fats	Fatty acids	Triglycerides

Vitamins and minerals

Minerals are vital to the body, and many have important exercise-related functions. For example, phosphorus and calcium are the main constituents of bone. Calcium is also needed for muscle contraction and nerve transmission. Several other minerals are involved in nerve transmission, including sodium and potassium. The complex process of energy metabolism

involves magnesium, sodium, potassium, iodine and iron. Iron is also required for red blood cell formation.

Vitamins are similarly important in many metabolic processes, as shown in Table 2.

Water

Water is essential for our bodies to work properly. It has several functions:

- it provides the medium in which most reactions in the body occur
- it acts as a lubricant for joints and the eyes
- it helps to regulate body temperature

The amount of water we need to drink varies from person to person, depending on age, climate, diet and the amount of physical activity we do. Water requirements are increased in hot climates and following exercise.

Dehydration is common among athletes, particularly those exercising in hot climates and/or at altitude, and can be serious. As little as 2% loss of body weight can result in impaired physiological responses and performance. Symptoms of mild dehydration include headache and fatigue.

Water replacement is essential, before, during and after exercise. Tap water is suitable for replacing lost fluid following mild or moderate exercise, but water alone is not the best solution for fluid replacement during or after vigorous or prolonged exercise. **Isotonic** drinks are more suitable and replenish water and carbohydrate stores. These are easily and cheaply made from diluted squash, some additional sugar and tiny amounts of salt.

Table 2

Compound	Exercise functions
Vitamin D	■ Controls the amount of calcium absorbed by the intestine ■ Essential for the absorption of phosphorus and for normal bone mineralisation and structure
Vitamin K	■ Required for normal bone structure
Vitamin C	■ Involved in the production of collagen, the protein in connective tissue (cartilage and bone) ■ Involved in the normal structure and function of blood vessels
Vitamin B1	■ Needed to release energy from carbohydrate ■ Involved in the normal function of the nervous system and the heart
Vitamin B2	■ Required to release energy from protein, carbohydrate and fat ■ Involved in the transport and metabolism of iron in the body
Niacin	■ Required for the release of energy from food and for normal functioning of the nervous system
Vitamin B12	■ Required for normal blood formation and function ■ Needed for the normal structure and function of nerves
Folic acid	■ Essential for normal cell division and in the formation of blood cells ■ Needed for the normal structure of the nervous system

Fibre

Fibre is important during exercise as it can slow down the time it takes the body to break down food, which results in a slower, more sustained release of energy. Good sources of fibre include wholemeal bread and pasta, nuts, seeds, fruits, vegetables and pulses.

Balanced nutrition

A balanced diet is essential for the performer. A balanced diet consists of an intake of food containing sufficient amounts of the nutrients required by the individual. The amount of food varies between performers, but in general performers require additional food because of the additional energy they are using. Attention should be paid to increasing fruit and vegetable intake.

The diet of a marathon runner needs special consideration. Endurance training makes the performer better at metabolising fats; therefore fat intake needs to be increased. Using fat will save carbohydrate for use later in an exercise (glycogen sparing). Similarly there needs to be a larger intake of carbohydrates to satisfy the energy demands of the performer. Marathon runners therefore need a diet that has a larger proportion of carbohydrates and fats than the average diet. All performers, including marathon runners, because of their training load have a higher metabolism than the average person, and require more vitamins and minerals to compensate. Therefore they need extra fruit, vegetables, dairy products and cereals compared with most other people.

Power/strength performers need to adjust their carbohydrate intake because of their energy demands, and they also need to increase their protein intake because of the increase in muscle repair and growth that will accompany their training.

Energy balance

The amount of food an individual needs varies from person to person depending on his/her basal metabolic rate (BMR) and level of activity. The BMR can be thought of as the rate at which a person uses energy to maintain the basic functions of the body. The BMR varies from person to person and accounts on average for about three-quarters of an individual's energy needs.

How much energy you need can be calculated by multiplying your BMR by a factor that takes account of your physical activity level. The more active you are, the higher your BMR becomes. Your energy intake through food needs to balance with the amount of energy you use.

Measuring percentage body fat using skinfold callipers

People vary, but for adults, change in body weight is a good guide to this energy balance.

Body fat

Ideally, performers should be encouraged to find the energy intake that enables them to maintain their weight within the desirable range for their height. Any excess energy taken in as food that is not used during daily energy expenditure is stored by the body as fat. A person who is very fat will have a body weight 20% or more above the desirable range. Body mass is made up of two components — lean body mass (muscles, bones and organs) and body fat. On average, men have 10–20% body fat, while women have 15–25%.

Percentage body fat can be estimated in different ways. The skinfold method involves measuring the thickness of the skin at specific locations around the body. The total of these various readings is then compared with norm tables to give a guide to percentage body fat.

A second method uses the body's natural resistance to electricity to make an estimate. This bioelectrical impedance method simply involves entering your gender, age, height and weight measures into a device that is then held while a tiny electric current is sent from one electrode to another and a percentage body fat estimate is generated.

Obesity is a condition in which excessive fat is accumulated in adipose tissue and impairs health. It is defined in adults as 40% body fat. Body weight is influenced by energy intake and energy expenditure. If a person regularly consumes more energy than he/she uses, the result will be a gain in weight and eventually he/she becomes overweight or obese. If a person regularly consumes less energy than he/she uses, weight loss results.

Body mass index

A useful way to judge whether a person is the appropriate weight is to work out his/her body mass index (BMI). This can be calculated by dividing a person's weight in kilograms by his/her height in metres squared:

Figure 1 BMI chart

Height (m) \ Weight (kg)	54	59	63	68	72	77	82	86	91	95	100	104	109	114	118	122	126	132	136	140	144	150	154	158
142.5	26	28	30	32	35	37	39	41	43	45	48	50	52	54	56	58	61	63	65	67	69	71	74	76
145	25	27	29	31	33	36	38	40	42	44	46	48	50	52	54	56	59	61	63	65	67	69	71	73
147.5	24	26	28	30	32	34	36	38	40	42	44	46	48	50	53	55	57	59	61	63	65	67	69	71
150	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	62	64	66	68
152.5	23	25	26	28	30	32	34	36	38	40	42	43	45	47	49	51	53	55	57	59	60	62	64	66
155	22	24	26	27	29	31	33	35	37	38	40	42	44	46	48	49	51	53	55	57	59	60	62	64
157.5	21	23	25	27	28	30	32	34	35	37	39	41	43	44	46	48	50	51	53	55	57	58	60	62
160	21	22	24	26	27	29	31	33	34	36	38	39	41	43	45	46	48	50	51	53	55	57	58	60
162.5	20	22	23	25	27	28	30	32	33	35	37	38	40	42	43	45	47	48	50	52	53	55	57	58
165	19	21	23	24	26	27	29	31	32	34	36	37	39	40	42	44	45	47	48	50	52	53	55	56
167.5	19	20	22	23	25	27	28	30	31	33	34	36	38	39	41	42	44	45	47	49	50	52	53	55
170	18	20	21	23	24	26	27	29	30	32	33	35	36	38	40	41	43	44	46	47	49	50	52	53
172.5	18	19	21	22	24	25	27	28	30	31	32	34	35	37	38	40	41	43	44	46	47	49	50	52
175	17	19	20	22	23	24	26	27	29	30	32	33	34	36	37	39	40	42	43	44	46	47	49	50
177.5	17	18	20	21	22	24	25	26	28	29	31	32	33	35	36	38	39	40	42	43	45	46	47	49
180	16	18	19	20	22	23	24	26	27	28	30	31	33	34	35	37	38	39	41	42	43	45	46	47
182.5	16	17	18	20	21	22	24	25	26	28	29	30	32	33	34	36	37	38	40	41	42	44	45	46
185	15	17	18	19	21	22	23	24	26	27	28	30	31	32	33	35	36	37	39	40	41	42	44	45
187.5	15	16	17	19	20	21	22	24	25	26	27	29	30	31	32	34	35	36	37	39	40	41	42	44
190	15	16	17	18	19	21	22	23	24	26	27	28	29	30	32	33	34	35	37	38	39	40	41	43
192.5	14	15	17	18	19	20	21	23	24	25	26	27	28	30	31	32	33	34	36	37	38	39	40	42
195	14	15	16	17	18	20	21	22	23	24	25	27	28	29	30	31	32	34	35	36	37	38	39	40
197.5	14	15	16	17	18	19	20	21	23	24	25	26	27	28	29	30	32	33	34	35	36	37	38	39

Low risk … More risk

Underweight | Low risk | Overweight | Obese with high risk of heart disease and other conditions

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

or by using a BMI chart (Figure 1).

A strong relationship exists between a high BMI (above 40) and the risk of associated diseases. Obesity is second only to smoking as a cause of cancer. People who are obese are more likely to suffer from coronary heart disease, diabetes, osteoarthritis (knees) and high blood pressure.

The importance of exercise

Many people in the UK have inactive lifestyles — they watch television, play computer games, and use a car rather than walking for short journeys. Few people have physically active jobs or do significant amounts of exercise in their free time. This lack of activity is an important factor in the increasing prevalence of obesity. Walking or cycling instead of using a car, going to exercise classes and taking part in sporting activities can all help a person maintain a healthy body weight by increasing energy expenditure.

People who are very overweight find it more difficult to be physically active and this may add to their health problems. People who are already overweight are usually encouraged to become more active as well as reducing the amount of energy in the food provided by their diet. Preventing obesity is important, as 'dieting' can be difficult, especially if dietary changes cannot easily be maintained as part of someone's lifestyle in the long term. Diets often 'fail', but this is usually because people revert to their old eating habits and/or levels of activity, rather than making changes for life.

The Department of Health recommends that in order to benefit health, individuals should participate in at least 30 minutes of moderate intensity activity on five or more days a week. Moderate intensity activity is defined as a level of activity that will:

- lead to an increase in breathing rate
- lead to an increase in heart rate (the pulse can be felt during this level of activity)
- lead to a feeling of increased warmth, possibly accompanied by sweating

Physical activity levels in England are low and a cause for concern across virtually all sections of the adult population and among some groups of children, notably teenage girls. Only 37% of men and 25% of women achieve at least 30 minutes of moderate intensity physical activity on 5 or more days of the week. Over the last 20–30 years, despite a small increase in the proportion of people participating in physical activity during leisure time, physical activity levels have fallen as it has become a smaller part of the daily routine.

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Measuring percentage body fat by the bioelectrical impedance method

Follow-up activity

Define or explain each of the following terms:

1 basal metabolic rate
2 percentage body fat
3 obesity
4 body mass index
5 seven classes of food
6 glucose
7 glycogen
8 carbohydrate
9 fat
10 triglycerides
11 protein
12 minerals
13 vitamins
14 isotonic
15 balanced diet

(Answers on p. 32)

Test your knowledge

1 (a) What are the seven classes of food? *(3 marks)*

(b) How does the diet required by a marathon runner differ from that required by an inactive person? *(3 marks)*

2 (a) How do performers benefit from having sufficient fibre in their diet? *(2 marks)*

(b) Why do people who exercise regularly need to make sure that they eat foods containing sufficient iron and calcium? *(4 marks)*

3 (a) What do you understand by the term basal metabolic rate (BMR)? *(2 marks)*

(b) How could you measure the amount of body fat of an athlete? *(2 marks)*

(c) What are the main health risks of being obese? *(2 marks)*

(Answers on p. 32)