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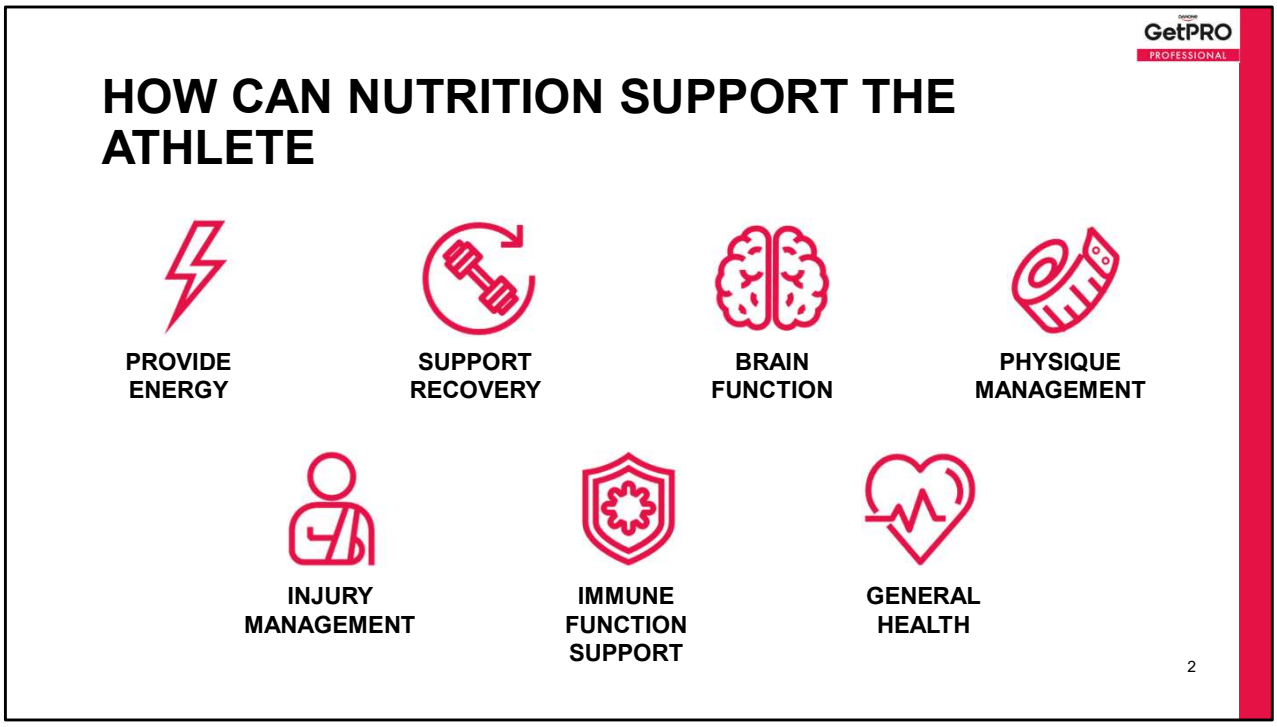
INTRODUCTION TO SPORTS NUTRITION FUNDAMENTALS

This resource was created by Michael Naylor, Head of Performance Nutrition, UK Sports Institute in collaboration with the GetPRO Professional nutrition team

This resource is for use under professional supervision



1. Provide energy: Nutrition ensures athletes consume enough calories, carbohydrates, and fats to fuel their physical activity and performance. Carbohydrates are particularly important as they are the body's primary source of energy during exercise. Adequate intake of protein also supports energy production and muscle repair.

2. Support Recovery: After intense exercise, the body needs nutrients to repair muscles, replenish glycogen stores, and reduce inflammation. Consuming a combination of carbohydrates and protein after exercise helps accelerate recovery by promoting muscle protein synthesis and glycogen replenishment.

3. Brain function: Nutrition plays a crucial role in cognitive function and mental performance, which are essential for athletes to maintain focus, concentration, and decision-making during training and competition. Nutrients like omega-3 fatty acids, antioxidants, and vitamins and minerals support brain health and function, which can often impact performance where it matters most.

4. Physique management: Nutrition helps athletes achieve and maintain their desired body composition and weight. Balancing calorie intake with energy expenditure, along

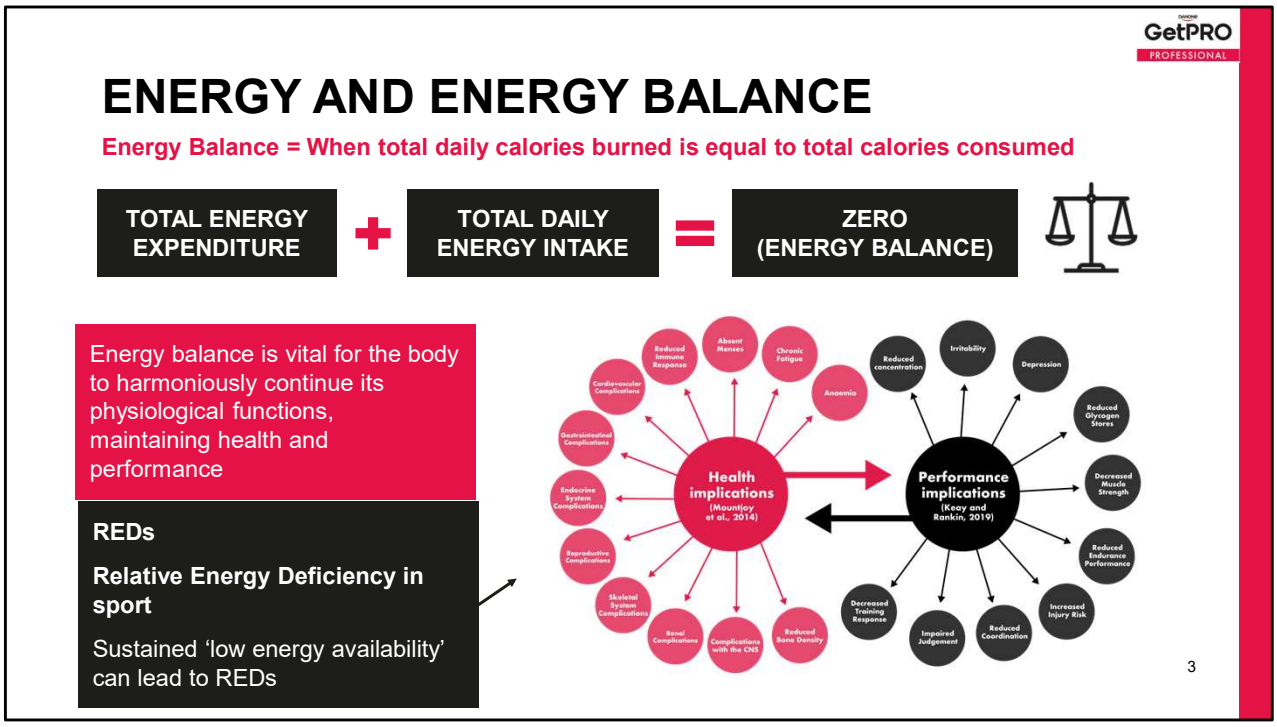
with adequate protein intake, supports muscle growth and maintenance while minimising fat accumulation.

5. Injury management: Certain nutrients, such as vitamins C and D, calcium, and protein, are essential for bone health and tissue repair. A well-balanced diet that includes these nutrients can help athletes recover from injuries more effectively and reduce the risk of future injuries.

6. Immune function support: Intense training and competition can temporarily suppress the immune system, making athletes more susceptible to illness. Nutrients like vitamin C, vitamin D, zinc, and antioxidants support immune function and help athletes stay healthy and perform at their best.

7. General health: Nutrition is essential for overall health and well-being, both in athletes and the general population. A balanced diet rich in fruits, vegetables, whole grains, lean proteins, and healthy fats provides essential nutrients that support optimal physiological function, metabolism, and disease prevention.

In summary, nutrition plays a multifaceted role in supporting athletes' performance, recovery, and overall health. By providing the necessary energy, nutrients, and support for various bodily functions, nutrition helps athletes optimise their performance and achieve their athletic goals.



In the body, energy is derived from the food we eat, primarily through the metabolism of carbohydrate's, fats and protein. Carbohydrates and proteins contain 4 calories per gram, whereas fats are more energy dense containing 9 calories per gram. The energy in these foods is used to power various physiological functions, including muscle contraction, nerve impulse transmission, metabolism, and maintenance of body temperature. Overall, energy is essential to life and is fundamental to all biological processes.

Energy balance, is when the amount of energy we consume, is equal to our total energy expenditure, and it is vital for our body to continue its physiological functions, maintaining health and performance.

When we consistently consume more energy than our body needs, the excess energy is stored in the body as fat and this can lead to weight gain.

When we consistently consume insufficient calories for our energy expenditure needs, it can lead to detrimental effects on overall health and well-being, including but limited to affecting growth, metabolism, immune function and susceptibility to disease. In sporting terms, insufficient energy availability is otherwise known as 'low energy availability' and it can lead to a condition known as Relative energy deficiency

in sport', or REDs, a syndrome that impacts health and performance and if left untreated, can cause long term detriments to our health. As you can see on the bottom right, the infographic shows the myriad of side effects REDs can have.

MACRONUTRIENTS

CARBOHYDRATE
4 kcal/g

PROTEIN
4 kcal/g

FATS
9 kcal/g

SACN RECOMMENDATIONS

Carbohydrate	Fat	Protein
50% TDEI	35% TDEI	15%
Effort to increase dietary fibre and lower free sugars	Focus on healthy fats and limit saturated fat to >10%	To support repair and growth of muscles, enzyme production and immune function

ATHLETES VARYING NEEDS

Carbohydrate	Fat	Protein
3 - 12g/kg/bw/d	20 - 30% TDEI*	1.2 – 2 g/kg/bw/day
Maximises glycogen replenishment	Absorption of fat-soluble vitamins, carotenoids, essential FA's and linoleic acids, essential for maintaining body weight and health	Maintain muscle mass due to the regular catabolic state and muscle breakdown endurance exercise can cause

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*Total daily energy intake

Bytomski JR. Sports Health 2018 Jan-Feb; 10(1): 47–53.

Macronutrients are the nutrients that the body needs in large amounts to function properly and provide energy. There are three primary macronutrients:

1. Carbohydrates: Carbohydrates are the body's main source of energy. They are found in foods like grains, fruits, vegetables, and legumes. Carbohydrates provide 4 calories per gram. Glycogen is stored form of glucose (what carbohydrates are converted into), that the body uses for energy when needed.

2. Proteins: Proteins are essential for building and repairing tissues, as well as for various bodily functions such as enzyme production and immune function. Sources of protein include meat, poultry, fish, dairy products, legumes, nuts, and seeds. Proteins also provide 4 calories per gram.

3. Fats: Fats are a concentrated source of energy and are important for cell structure, hormone production, and nutrient absorption. Sources of dietary fat include oils, butter, avocados, nuts, seeds, and fatty fish. Fats provide 9 calories per gram.

An adequate balance and consumption of macronutrients are important for maintaining overall health and supporting bodily functions. In the UK, the Scientific Advisory Committee on Nutrition (SACN), recommends around 50% total dietary

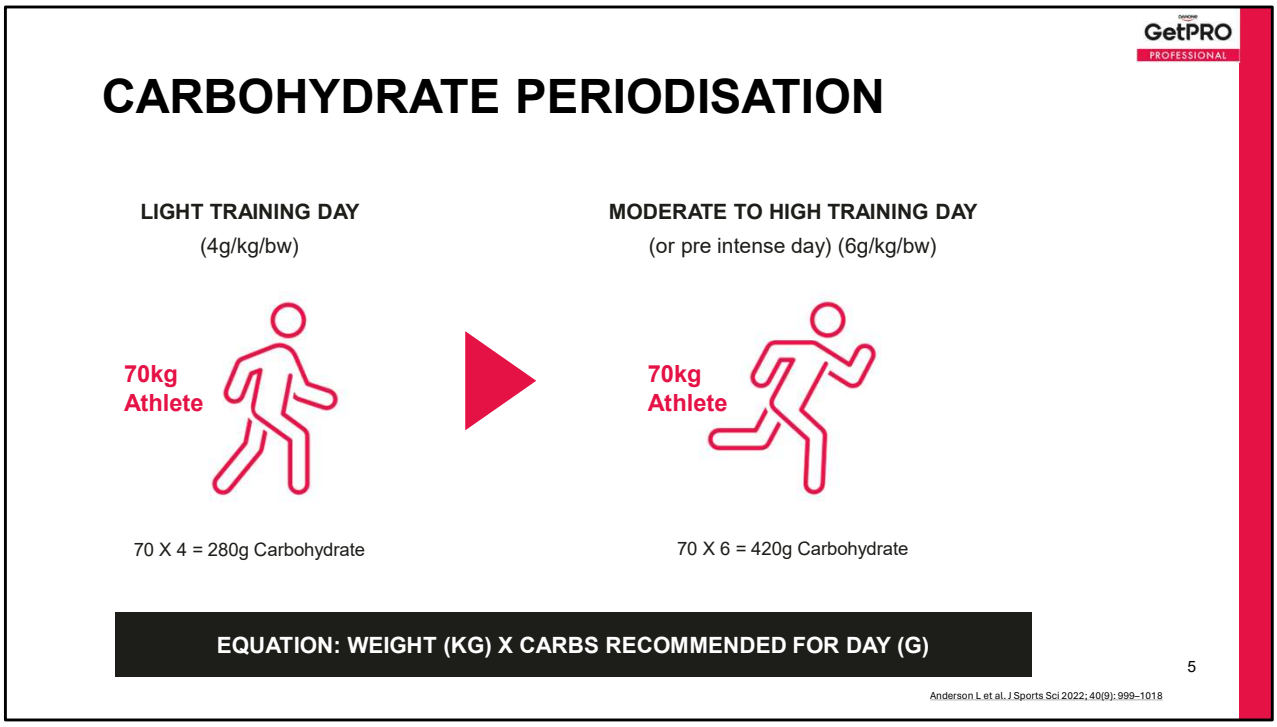
intake carbohydrate, with an effort to full the majority of this with higher in dietary fibre and lower in free sugars.

SACN recommends dietary fat should contribute around 35% of total energy intake for adults, including healthy fats such as monounsaturated and polyunsaturated fats found in foods such as nuts, seeds, avocados and oily fish. Saturated fats should be limited to no more than 10% of total energy intake.

SACN then recommends that protein intakes should contribute around 15% of total energy intake for adults. Protein rich foods include meat, poultry, fish, eggs, dairy products, legumes, nuts and seeds, to support repair and growth of muscles, enzyme production and immune function.

However, for athletes, it may be more practical to look at your needs in grams per kg body weight, where quantities and proportions may vary depending upon your goals and activity levels. For example, we know strength and power athletes will likely need around 1.6-2g / kg/ bw per day protein, while endurance athletes will need around 1.2-1.6 g/kg/bw protein per day, in order to build and repair tissues. Whereas carbohydrate intakes may vary from 3g/kg/bw per day to as high as 12 g/kg/bw per day, depending upon ones goals and activity levels. (Vitale & Getzin, 2019, Pramuková et al, 2011., Bytomski, 2018). Fats should remain around 20 to 35%, with the international Olympic committee recommending no less than 15-20% total calories from fat because it is essential for many cell processes in the body, including cell membrane structure, absorption of fat-soluble vitamins, hormone regulation, brain health and energy for muscle metabolism. (Bytomski, 2018)

Bytomski 2018:
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5753973/



The amount of carbohydrate individuals need not only differs from person to person, but it will also differ day to day, depending not only on the individuals training, but also their individual goals. They might have goals around their training / competing demands, and so may need extra fuel to support this, or they may reduce their carbohydrate intake at certain times to support their body composition goals.

At a headline level, you can see from the example above, that on a light training day for a 70kg athlete, individuals might require 4g carbohydrate per kg body weight per day. So as you can see, if an athlete is 70kg, you times that by 4 and you get 280g carbohydrate.

If it was a more intense training day, or the day before an intense match or competition, the individual might want to increase their carbohydrate to 6g/kg/bw per day. The same formula is used, you times the body weight, in this case 70kg by 6, which equates to 420g carbohydrate for the day.

Anderson et al, 2022 - https://www.tandfonline.com/doi/epdf/10.1080/02640414.2022.2044135?needAccess=true

MICRONUTRIENTS

Micronutrients consist of vitamins and minerals and they are typically obtained through a balanced diet that includes a variety of fruits, vegetables, wholegrains, lean proteins and dairy products… eating the rainbow is a great way to boost all the essential micronutrients in your diet.

Nutrient	Foods High in Nutrient	Effects on the body
Vitamin A	Sweet potatoes, carrots, spinach, kale, mangoes	Essential for vision, immune function, skin health, and cell growth
Vitamin B	Whole grains, lean meats, nuts, dairy products, leafy greens, fish, potatoes, bananas, eggs	Crucial for brain development and immune function. Supports energy metabolism and important for neurological function
Vitamin C	Citrus fruits, strawberries, bell peppers, broccoli	High in antioxidants, boosting immune function
Vitamin D	Fatty fish (salmon, mackerel), fortified dairy, sunlight exposure, eggs	Facilitates calcium absorption, crucial for bone health
Vitamin E	Nuts and seeds, spinach, broccoli, sunflower oil	High in antioxidants, protecting cells from damage
Calcium	Dairy products, leafy greens, fortified foods	Essential for bone health, nerve function and blood clotting
Iron	Red meat, lentils, spinach, fortified cereals	Critical for oxygen transportation in the blood and energy production
Potassium	Bananas, oranges, potatoes, beans	Regulates fluid balance, nerve signals and muscle contractions
Zinc	Meat, dairy, nuts, legumes	Important for immune function and wound healing

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Micronutrients are essential nutrients that the body needs in smaller amounts compared to macronutrients, but they are still vital for various physiological functions and overall health. Inadequate intake of micronutrients can lead to deficiencies, which can have negative effects on health and wellbeing. This is where the common saying of ‘eat the rainbow’ really does ring true.

MICRONUTRIENTS

Nutrient	Daily adequate intake recommendations	Food sources
Calcium	9-18 yrs: 1300 mg/day 19-50 yrs: 1000 mg/day 51-70 yrs: 1200 mg/day Amenorrheic athletes: 1500 mg/day	1 cup Skimmed milk: 300mg 1 cup fortified soy milk: 280mg ½ cup boiled broccoli: 89mg 1 cup chickpeas: 80mg
Iron	Males 19+ years: 8.7mg Females 19 – 49yrs: 14.8mg Females 50+ yrs: 8.7mg	Red meat such as beef: 2.47mg per 100g Kidney beans: 8.2mg per 100g raw Fortified breakfast cereals (Weetabix: 4.5mg per 2)

VITAMIN D FOOD SOURCES: 10 (MG)/DAY

- Oily fish – such as salmon, sardines, herring and mackerel
- Red meat
- Egg yolks
- Fortified foods – such as plant milks and breakfast cereals

10 ug (micrograms/mcg) recommended between September - March

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Kunstel K. Current Sports Medicine Reports. 2005; 4(4):203-206.
Solberg A, Reikvam H. Life (Basel). 2023 Oct; 13(10): 2007.

Despite all micronutrients being important, there are some that athletes should be particularly aware of in order to ensure optimum health and performance. For example, vitamin D and calcium play a key role in the reformation of bone mass. Whether the objective is to maximise attainment of peak bone mass reached in early adulthood, or to prevent bone loss with advancing age, dietary calcium intake alongside optimal vitamin D are key factors. Low bone mass accounts for around 50-70% bone stress injuries, something athletes definitely want to avoid! Additionally, athletes may lose calcium through sweat and so it is important adequate calcium is replaced. As you can see from the table, athletes who are amenorrheic (absence of menstrual cycle) due to low energy availability, are advised to consume an increased calcium dose of at least 1500mg / day, due to the associated loss in bone mass.

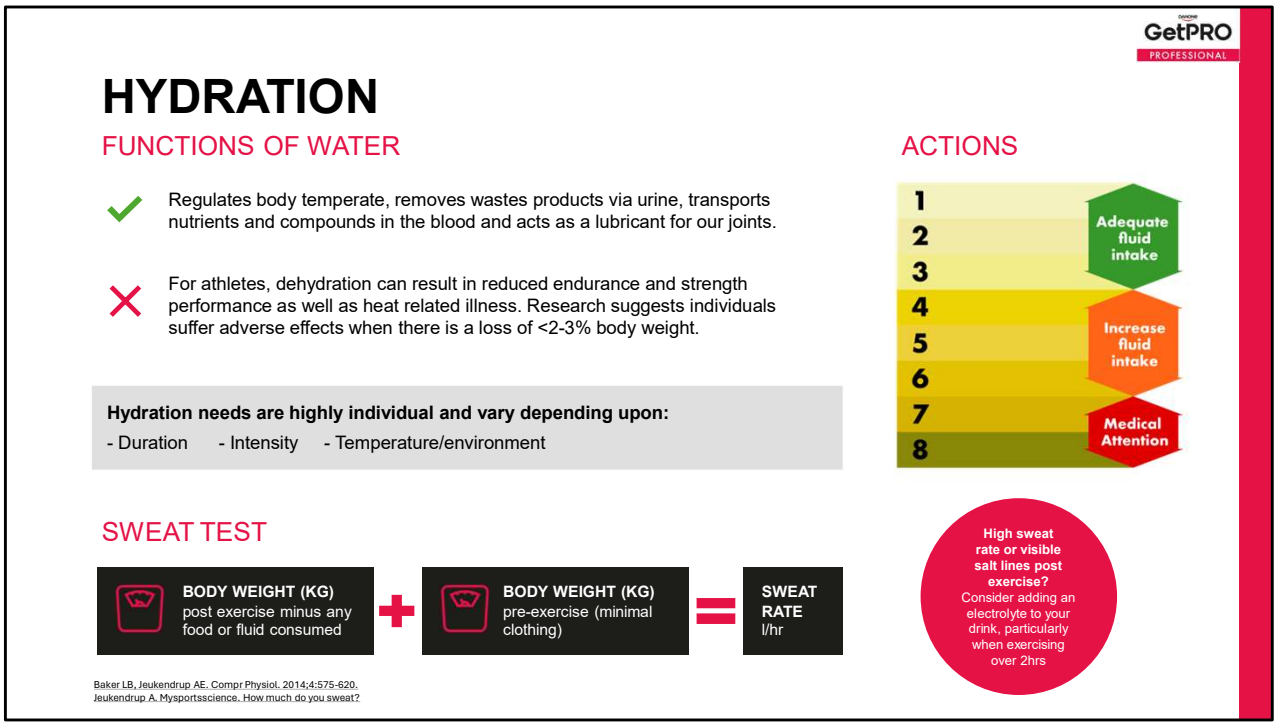
Importantly, vitamin D facilitates the absorption of calcium and so it is vital individuals have adequate vitamin D. Although vitamin D can be obtained through food sources, such as oily fish, red meats or egg yolks, the majority is actually obtained through sunlight! Now unfortunately in the UK, sunlight is limited throughout the autumn and winter months, therefore the Department of Health and Social Care, recommends that adults and children over the age of 4, between the months of September through to around March, take a daily supplement of 10 micrograms (400 IU) per day if you aren't outdoors very often, or wear clothes that limit your exposure to sunlight.

If you have dark skin – for example you have an African, African-Caribbean or south Asian background – you may also not make enough vitamin D from sunlight and you may want to consider taking a daily supplement containing 10 micrograms of vitamin D throughout the year.

Iron: Ferritin in the blood is a good way to measure iron status. Iron is important for athletes because they experience increased losses in training cause by micro-ischemia, hemolysis, sweating etc. Additionally, women who experience menstrual bleeding will be prone to further iron losses.

Calcium: https://journals.lww.com/acsm-csmr/fulltext/2005/08000/calcium_requirements_for_the_athlete.5.aspx

Iron: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10608302/



Water is a major constituent of the body, making up as much as 50 to 70%. Water has many functions including regulating body temperature, removing waste products via urine, transporting nutrients and compounds in the blood and acting as a lubricant for our joints.

For athletes, dehydration can result in reduced endurance and strength performance as well as heat related illness. Research suggests individuals suffer adverse affects when there is a loss of **<2% body weight**.

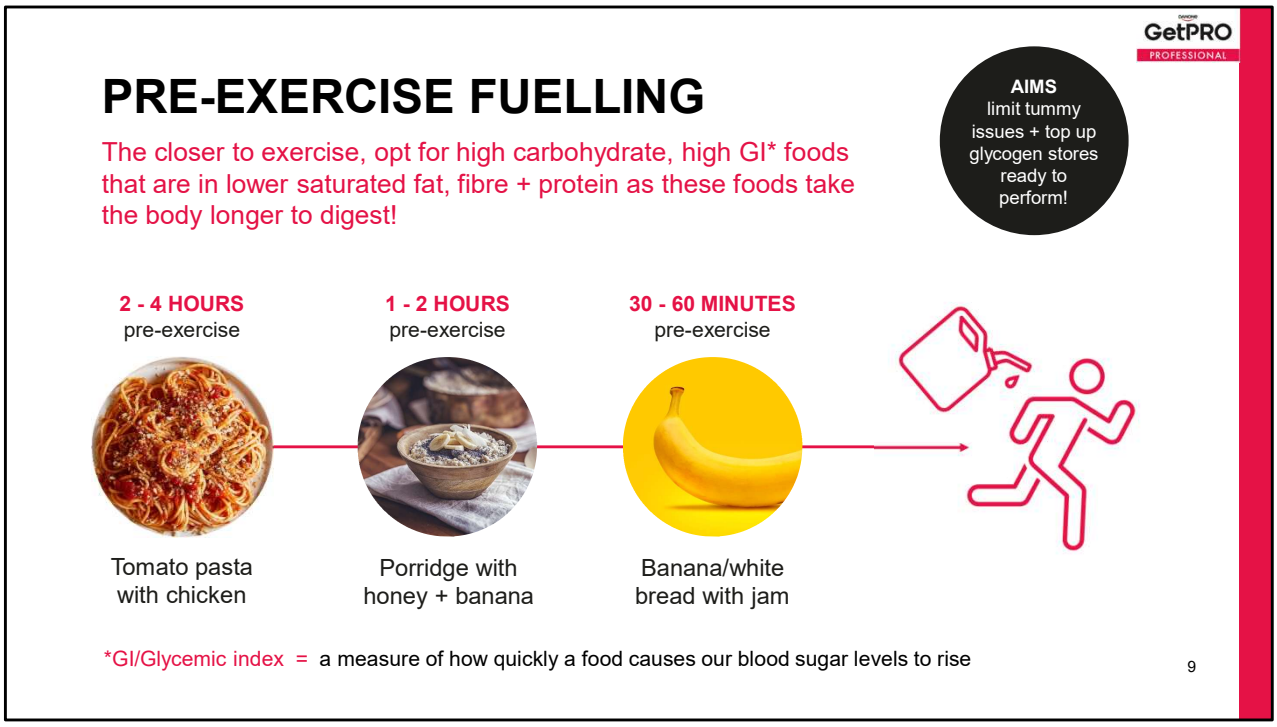
A great way to measure hydration status, is using the chart on the right-hand side, where aiming for a pale straw colour is optimal. However, during exercise, this isn't very practical!

SWEAT TEST: A useful free tool, can be to perform a sweat test, where you weigh yourself before and after 1hr of exercise with minimal clothing, toweling off any residue sweat and subtracting any fluid/food consumed from your post exercise weight. The difference equates to your sweat rate in litres per hour. Importantly, this figure will change depending on the intensity and environment / temperature and so retesting in differing environment's will be necessary.

In addition, the amount of sodium in your sweat will vary depending on various factors such as sweat rate, exercise intensity, duration and environmental conditions. Look out for visible signs of salt losses, such as white lines on your clothing. This may be a sign that you want to consume an electrolyte before and or during your session in that environment, or if exercising over 2hrs.

Paper: https://www.researchgate.net/profile/Asker-Jeukendrup/publication/261517517_Optimal_Composition_of_Fluid-Replacement_Beverages/links/5a717a11aca272e425ed9a82/Optimal-Composition-of-Fluid-Replacement-Beverages.pdf

Jeukendrup A. Mysportsscience. How much do you sweat? https://www.mysportscience.com/post/2017/07/14/how-much-do-you-sweat



A lot of the time for health, low GI, high fibre meals are recommended, however these foods take the body longer to process and so may lead to gastrointestinal issues if consumed too close to exercise. Everyone's gut sensitivity is different, and the intensity of your workout will also impact the incidence of gastro issues. As a rule of thumb, consuming a meal high in carbohydrate, with moderate protein, fat and fibre 2-4 hours before your moderate to low intensity training, should limit the incidence of gastrointestinal issues.

Any exercise 1-2 hours before exercise means less time for digestion, and so options lower in fat and fibre but high in carbohydrate should be prioritised. This is because when we exercise, our bloodstream is diverted away from the gut and to the working muscles', meaning the digestion of food is slowed.

30-60 minutes before exercise. Here digestibility is key as no one wants to be running around while food is only just beginning to be digested. If eating close to exercise, prioritise foods higher in carbohydrate and lower in fibre and fat. Faster releasing carbs (high GI) are of benefit due to them being absorbed into the bloodstream more quickly therefore providing you more efficient energy once exercise begins. See them as your 'superfuel' at a garage!

DURING EXERCISE NUTRITION

High Gi foods first when practically possible

Gels / Carb drinks when food less practical

How much fuel?

Duration	Carbohydrate per hour (g)
Up to an hour	Mouth rinse or nothing
1-2 hrs	30g carbohydrate
2hrs +	60g per hour
2.5hrs +	90g per hour

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During exercise, high GI foods are recommended as they provide a quick source of readily available energy, helping replenish glycogen stores and provide glucose for fuel. A food first approach where practical is recommended, opting for foods such as bananas, soreen, banana bread or fruit juice.

During day to day life, often energy gels and drinks are often not required. However, during high intensity or extremely long activities such as a 4hr cycle ride, where it may be difficult to consume food based carbohydrate, it may be beneficial to consume a carbohydrate drink and / or energy gel due to their high GI content, providing a quick release of energy and therefore helping support performance.

Post exercise refuel is often an area forgotten about, however it is a critical part of helping you recover faster and therefore perform again sooner. A great way to think about recovery is the 3 R's …

REFUEL: Following exercise, particularly exercise over 1hr of moderate to high intensity work, will have depleted your glycogen stores. During the first 2 hours following exercise, glycogen synthesis, or in other words, your body's ability to refuel, is at it's peak. Therefore, it is ideal to consume carbohydrate within the first 2 hours of completing your workout.

REPAIR: Consuming high-quality proteins is a great way to repair muscle tissue and stimulate muscle growth.

REHYDRATE: Rehydrating with fluid and electrolytes based on sweat loss is key to helping your body adapt and recover.

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FOOD FIRST APPROACH

Where practically possible, nutrient provision should come from real foods and drinks rather than from isolated food components or dietary supplements.
As top researchers have stated "nutritional programs should prioritise food over supplements, as whole food sources offer energy and macronutrients as well as a range of micronutrients, polyphenols, fibre and other bioactive compounds that can have positive benefits."

When food first may not be practically possible:

- Some nutrients are difficult to obtain in sufficient quantities in the diet
- Some nutrients are abundant only in foods individual's dislike
- The nutrient content of some foods can vary – e.g. caffeine
- Concentrated doses of some nutrients are required to correct deficiencies and/or promote immune tolerance
- Some foods may be difficult to consume around/during exercise
- Tested supplements may help if food hygiene concerns/contamination

WHEN CONSIDERING A DIETARY SUPPLEMENT THINK:

- Does it pose any harm?
- Is it legal?
- Can I practically consume this through food?
- Does it promote health?
- Does it promote performance?

Close GL et al. Int J Sports Nutrition and Exercise Metabolism. 2022; 32(5):371-386.

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A food first approach, where practically possible, should be adopted in the first instance, as whole food sources offer energy and macronutrients, as well as a range of micronutrients, polyphenols (natural compounds often found in plants that have antioxidant properties) and fibre that can have positive benefits.

Although recommended to adopt a food first approach, sometimes it is not practically possible. The quote above is a useful tool to use when considering a supplement (see 'when considering a dietary supplement')

Reasons supplement usage may be more suitable include:

- Some nutrients are difficult to obtain in sufficient quantities in the diet or may require excessive energy intake and/or consumption of other nutrients. A good example of this is vitamin D. an essential vitamin, but one that is difficult to obtain through food, due to our main source being through the absorption of sunlight on our skin.
- Some nutrients are abundant only in foods athletes do not eat/like
- The nutrient content of some foods with established ergogenic benefits is highly variable. A good example of this is caffeine, with chains varying hugely in their caffeine content, despite it being the same drink order. The mg of caffeine will likely differ again depending on factors such as the barista.

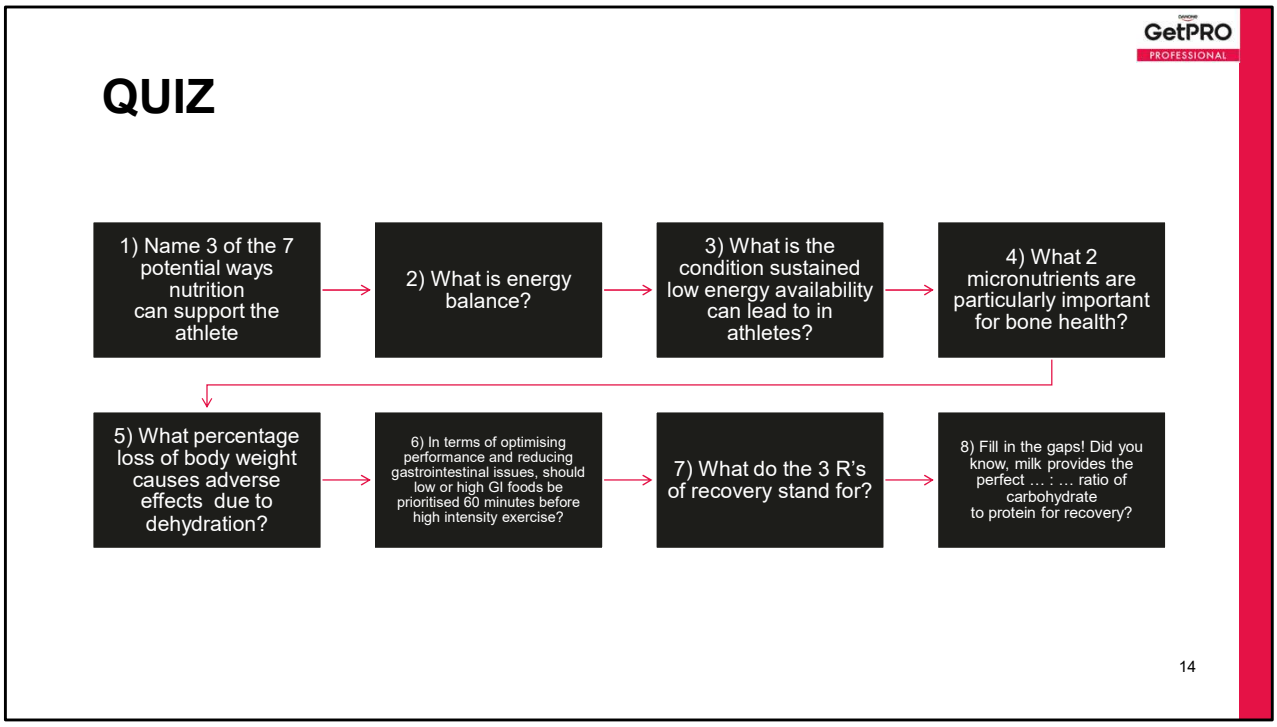
- Concentrated doses of some nutrients are required to correct deficiencies and/or promote immune tolerance, such as iron deficiencies.
- Some foods may be difficult to consume immediately before, during or immediately after exercise. For example, at half time during a rugby game, a gel may be more tolerable than a banana when about to run around a pitch soon after.
- Tested supplements could help where there are concerns about food hygiene or contamination. If an individual is unable to consume certain sources, such as consuming chicken would pose a risk, a tested supplement may pose less risk.

First and foremost, asking yourself if a supplement will harm is a vital consideration. If an elite athlete, it is also imperative to ensure it is legal. Look out for the 'informed sport' label on products and ensure to keep a record of the batch code. Overall, when deciding upon whether to take a supplement or not, ensure you have considered all options and consulted with professionals.

Key paper: https://journals.humankinetics.com/view/journals/ijsnem/32/5/article-p371.xml

SUMMARY

- Nutrition can support an individual's overall health and performance, often at pivotal points in sport!
- The components of the carbohydrates, fats and proteins that make up our energy balance will differ day to day, depending on individual goals and activity levels.
- Consuming a range of fruits, vegetables and grains will help ensure sufficient micronutrients are in your diet.
- Glycogen stores are limited (~500g) highlighting the importance of topping up stores if exercising at high intensities or for long durations (>80mins) if the aim is to maximise performance.
- Think of the 3 R's when it comes to recovery! Repair, Replace, Replenish!
- A food first approach should be adopted first where practically possible. If not, consider a supplement providing it poses no risk to health or performance, and is legal.
- Hydration needs vary greatly. Use the hydration chart to assess and respond accordingly.



Answers

1. Provide energy, Support Recovery, Brain function, Physique management, Injury management, Immune function support, General health
2. When total energy expenditure – total daily energy intake = zero (energy balance)
3. Relative energy deficiency in sport (REDs)
4. Calcium + vitamin D
5. 2-3%
6. High
7. Refuel, Repair, Rehydrate
8. 3:1

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