Course 8

Nutrition, hydration and supplementation

Learning objectives of the course

Upon completion of this course, the student will be able to:

- Know the basic principles of sports nutrition (carbohydrates, proteins, fats, timing).
- Apply the rules of appropriate hydration before, during and after exercise.
- Recognise disorders related to dehydration and hyponatraemia.
- Discuss the benefits and risks of main supplements (creatine, caffeine, iron, vitamin D, etc.).
- Identify the signs of RED-S (Relative Energy Deficiency in Sport) and eating disorders.
- Know how to refer the athlete to a sports nutritionist.

Introduction: diet, a pillar of performance and health

An athlete may have the most sophisticated training, but poorly adapted nutritional or fluid recovery will cancel its benefits. Conversely, poor nutrition can promote injuries, hormonal disorders, chronic fatigue or overtraining.

The coach is not a nutritionist, but must know the essential basics to:

- Advise common-sense dietary hygiene.
- Detect at-risk behaviours (severe restrictions, dangerous supplements, eating disorders).
- Refer to a specialist when necessary.

1. Nutritional basics for athletes

1.1 The three macronutrients

Macronutrient	Main role	Daily needs (athlete)	Sources
Carbohydrates	Fuel for exercise (glycogen, glucose)	5–10 g/kg/day depending on intensity (endurance: 8–12 g/kg)	Pasta, rice, bread, potatoes, fruits
Proteins	Muscle repair, enzyme synthesis	1.6–2.2 g/kg/day (beyond that, little benefit)	Meat, fish, eggs, dairy products, legumes
Lipids	Long-duration energy, hormones, fat-soluble vitamins	1.0–1.5 g/kg/day (20–35% of calories)	Olive oil, nuts, oily fish, avocado

Total energy: a high-level athlete may need 3,000 to 6,000 kcal/day depending on the sport.

1.2 Nutritional timing (around training)

Period	Objective	Example snack
Before exercise (2–4 h)	Fill glycogen stores, avoid hypoglycaemia	Pasta, rice + low-fat protein
During exercise (> 1 h)	Maintain blood glucose, hydrate	Carbohydrate drink (30–60 g carbs/h), bar, gel
After exercise (30 min – 2 h)	Glycogen resynthesis + muscle repair	1–1.5 g/kg carbs + 0.3–0.4 g/kg protein (e.g., yoghurt + fruit)

Metabolic window: the first 30 minutes after exercise are ideal for glycogen resynthesis (faster). However, this is not an absolute obligation if the next meal is taken within 2 hours.

1.3 Essential micronutrients (special attention in athletes)

Micronutrient	Effect of deficiency in athletes	At-risk populations
Iron (common deficiency)	Fatigue, decreased VO_2max, anaemia	Women (menstruation), endurance athletes, vegetarians
Vitamin D	Stress fractures, muscle weakness	Indoor athletes, winter, northern latitudes
Calcium	Osteoporosis, stress fractures	Women, low-impact sports
Magnesium	Cramps, fatigue, sleep disorders	Sports with heavy sweating

Note: do not supplement blindly. Blood tests (ferritin, 25-OH vitamin D, calcium, magnesium) should guide supplementation.

2. Hydration and related disorders

2.1 Fluid needs

- Average losses during exercise: 0.5 – 2 L/h depending on intensity, temperature, humidity, clothing.
- Rule: drink before thirst (thirst appears only after a loss of 1–2% of body weight).

2.2 Hydration strategy

Period	Amount	Type
Before exercise (2–4 h)	5–7 mL/kg (≈ 300–500 mL)	Water or slightly salted drink
During exercise	150–250 mL every 15–20 min	Water for < 1 h; carbohydrate-electrolyte drink if > 1 h or hot
After exercise	1.2–1.5 L per kg of body weight lost	Water + salt (or rehydration drink)

Simple calculation: weigh before and after session → 1 kg lost = 1.2–1.5 L to drink.

2.3 Hydration-related disorders

Disorder	Mechanism	Signs	Prevention
Moderate dehydration (2–4% body weight)	Loss of water + electrolytes	Thirst, fatigue, cramps, performance drop	Drink regularly
Severe dehydration (>5%)	Vascular collapse	Confusion, hypotension, cessation of sweating → heat stroke	Medical alert
Hyponatraemia (dilution)	Excess water without sodium, often during long exercise (>4 h)	Nausea, headache, confusion, cerebral oedema	Drink to thirst, do not overdrink, add salt

Note: during long efforts (marathon, trail), drinking only water without salt can be dangerous. Prefer an isotonic drink.

3. Supplementation: benefits and risks

Supplementation never replaces a balanced diet. For the majority of amateur athletes, it is useless. For some high-level athletes or in cases of proven deficiency, some supplements have scientifically proven benefits.

3.1 Supplements with good evidence (Category A, AIS 2024 position)

Substance	Use	Benefit	Risks / precautions
Creatine	Sprint, strength, power sports	↑ power, ↑ lean mass, gain in repetitions	Possible weight gain, rare cramps, avoid if renal insufficiency
Caffeine	Endurance, combat sports, team sports	↓ perceived fatigue, ↑ vigilance, fat mobilisation	Overdose (heart, anxiety); effective dose 3–6 mg/kg 60 min before
Nitrates (beetroot juice)	Endurance, 5–20 min efforts	↓ O_2 cost, ↑ time to exhaustion	Possible harmless urine discolouration
Beta-alanine	Efforts of 1–4 min (e.g., 400 m, swimming)	Buffers muscle acidosis	Paraesthesia (tingling, benign)
Iron (only if deficient)	Anaemic or low-ferritin athletes	↓ fatigue, ↑ VO_2max	Iron overload (toxic) → prescribed dosage
Vitamin D (if deficient)	All sports, especially winter	↑ strength, ↓ stress fractures	Possible overdosage (calcaemia)

3.2 Ineffective or risky supplements (to avoid)

Substance	Problem
BCAA (branched-chain amino acids)	Useless if protein intake sufficient; complete mixture better
Glutamine	No proven benefit on immunity or recovery
High-dose antioxidants (vitamin C, E, beta-carotene)	May inhibit training adaptations (redox signal suppressed)
"Fat burner" products	Often of doubtful efficacy, sometimes containing prohibited stimulants
Testosterone boosters	Unproven, sometimes doping

3.3 Risk of contamination with doping substances

- Dietary supplements (especially bought online) may contain prohibited substances (anabolic steroids, masked stimulants). Recommendation:
- Prefer certified brands (e.g., Informed-Sport, batch tested).
- Never recommend a supplement without medical or sports nutritionist advice.

4. RED-S (Relative Energy Deficiency in Sport)

4.1 Definition

RED-S is a syndrome due to relative energy deficiency: energy intake is insufficient relative to training expenditure, not necessarily associated with an eating disorder (but can lead to one). It replaces the former "female athlete triad" and also applies to males.

4.2 Consequences of RED-S (systems affected)

System	Consequences
Metabolic	Decreased basal metabolic rate, chronic fatigue
Female hormonal	Amenorrhoea (absence of periods) or irregular cycles
Male hormonal	Decreased testosterone, libido, erectile dysfunction
Bone	Stress fractures, early osteoporosis
Muscle	Loss of muscle mass, weakness
Immune	Recurrent infections
Psychological	Irritability, depression, food obsession

4.3 Warning signs for the coach

- Unintentional weight loss or stagnation despite increased training volume.
- Persistent fatigue, decreased performance despite training.
- In women: absence of periods for >3 months (excluding hormonal contraception).
- Repeated stress fractures.
- Obsessive talk about food, weight, body composition.

4.4 What to do

- Do not “force to eat” but refer to a sports physician and a nutritionist.
- Temporarily reduce training load.
- Educate the athlete on the importance of available energy for health and performance.

5. Eating disorders in athletes

Eating disorders are more common in weight-category sports (weightlifting, judo, wrestling), aesthetic sports (gymnastics, figure skating, dance) and endurance sports.

5.1 Main eating disorders

Disorder	Characteristics
Anorexia nervosa	Severe restriction, fear of weight gain, low weight
Bulimia nervosa	Binge eating followed by compensatory behaviours (vomiting, laxatives)
Binge eating disorder	Binge eating without compensation
Orthorexia (not official)	Obsession with “healthy” eating → excessive restrictions

5.2 Signs to detect

- Rapid weight loss, emaciation, or unstable weight.
- Avoidance of group meals.
- Going to the toilet just after meals.
- Damaged teeth (acid vomit), calluses on fingers (self-induced vomiting).
- Marked anxiety around the scale.

5.3 Role of the coach

- Do not comment on weight or shape (except in weight-category sports, with caution).
- Report concerns to the physician or medical staff.
- Do not isolate the athlete.
- Refer to a specialist consultation (psychiatrist, psychologist specialised in eating disorders, nutritionist).

Key points to remember

- ✓ Carbohydrates = essential fuel (5–10 g/kg/day), proteins = repair (1.6–2.2 g/kg/day).
- ✓ Hydration: drink before thirst, add salt + carbohydrates if exercise >1 h. Beware of hyponatraemia (excess plain water).
- ✓ Useful supplementation: creatine, caffeine, nitrates, beta-alanine, iron/vitamin D if deficient. The rest is useless or risky.

- ✓ RED-S: relative energy deficiency → amenorrhoea, stress fractures, performance decline. Screening by the coach.
- ✓ Eating disorders: do not trivialise, refer to a specialist.
- ✓ Never prescribe supplements without medical advice (risk of doping, toxicity).

Appendix: Practical sheet – Hydration and drinks

Situation	Recommended drink
Exercise <1 h, normal temperature	Water
Exercise 1–2 h, temperate	Water + sugar (30 g/L) + salt (1 g/L) or isotonic drink
Exercise >2 h, heat	Carbohydrate-electrolyte drink (40–80 g/L carbs, 500–700 mg/L sodium)
Rapid recovery	Chocolate milk, protein drink, or water + sweet-salty snack

Dehydration detection: urine colour (dark = dehydration).