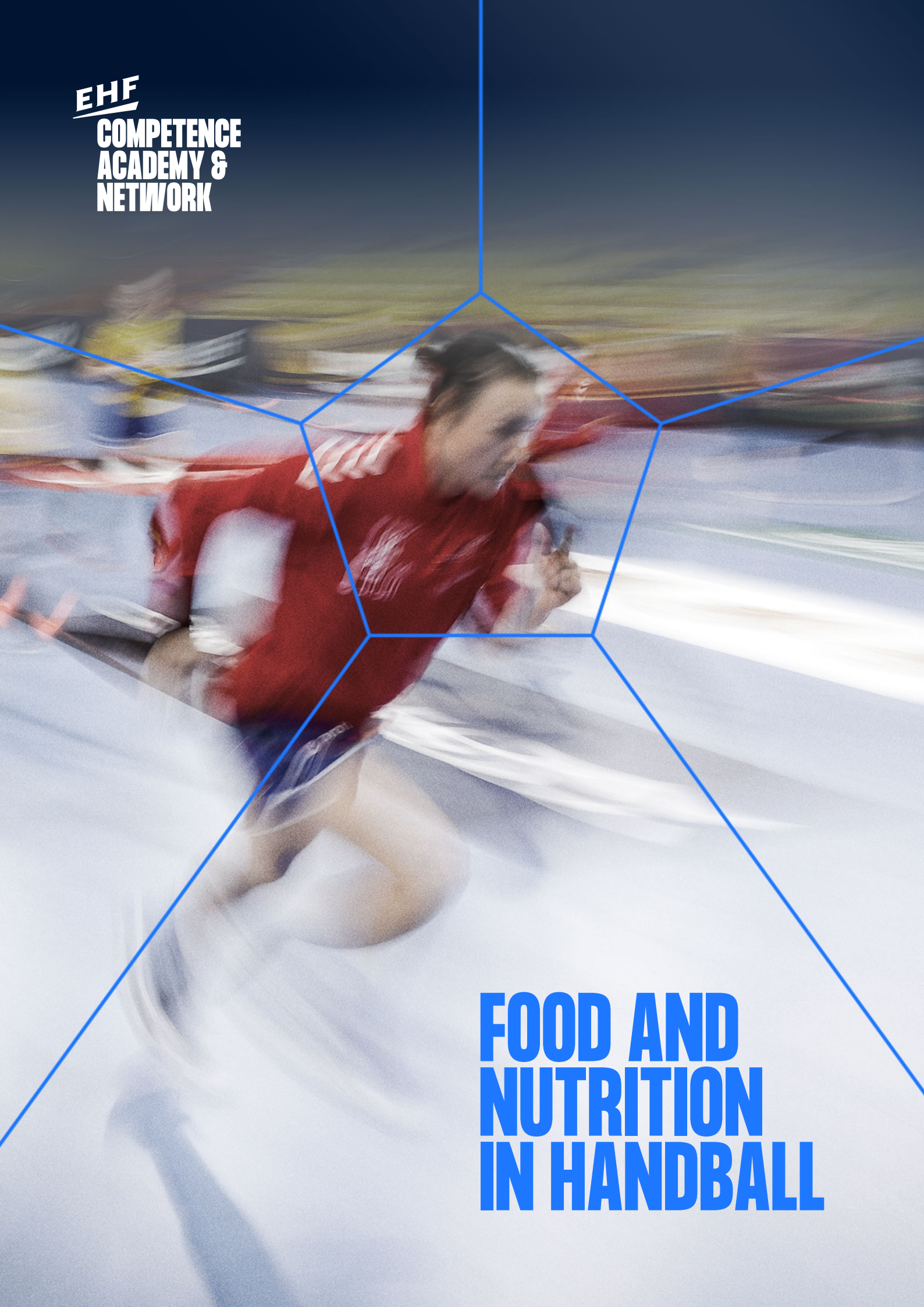
EHF
COMPETENCE ACADEMY & NETWORK



FOOD AND NUTRITION IN HANDBALL

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CONTENTS

1. INTRODUCTION

In sports, a correct choice of food consumption and the intake timing are essential during training and competition.

The objectives of sports nutrition include the following categories:

- Increasing sport performance
- Improving digestion conditions on competition days
- Improving body composition
- Supporting efficient recovery
- Preventing pathologies and injuries

One of the determining aspects in sports performance is the recovery from fatigue after exercise. Athletes who recover faster from fatigue will have an advantage for their subsequent training or competition. The main mechanisms of fatigue, common to high-intensity sports appear to be related to:

1. The depletion of energy substrates (Glycogen, adenosine triphosphate (ATP) and phosphocreatine)
2. Accumulation of hydrogen ions (Hydrogen ions, lactate, inorganic NH4)
3. Muscle and tendon damage
4. Temperature accumulation
5. Exercise-induced injury
6. Hydro electrolytes and their alterations (Water, Sodium, etc.)
7. Amino acid changes
8. Transient immunity
9. Gene activation
10. Fatigue associated with travel

During physical-sports activity, compared to the resting state, a large amount of energy is required in a short period (anaerobic sports, such as sprints, throws, jumps...), while in others, the requirements are moderate but constant and long lasting (long endurance sports such as marathon, long distance triathlon, mountaineering...). Thus, there are three energy systems involved that interact with each other in the production of energy through the “energy currency” ATP; fundamental nucleotide for obtaining cellular energy (Urdampilleta, 2013).

ATP is the only molecule that can be directly converted into energy. After it is used it can be recovered through 3 main energy pathways: 1) alactic anaerobic system, 2) lactic anaerobic system and 3) aerobic system. These are classified according to the substrate they use to produce energy, as well as, whether they carry out this biochemical process in the presence of oxygen or not. Thus, according to the substrate used, the speed of obtaining energy (power versus bioenergetic capacity) and the way of using energy; aerobically (in the presence of oxygen) or anaerobically (without oxygen) we can differentiate the different metabolic pathways (Urdampilleta, 2013). To achieve the objectives above satisfactorily, the first aspects to consider are, the energy substrates used during physical activity and their characteristics will be presented in table 1:

Table 1. Characteristics of energy pathways, type of fibers involved and metabolic toxicity (Urdampilleta, 2013).

	Alactic anaerobic metabolism	Lactic anaerobic metabolism	Aerobic metabolism (Oxidative)
Energy source	Phosphagen	Glucose	Carbohydrates, fats, aminoacids
Speed at which it forms energy	Very fast	Fast	Slow
Energy production	Very little	Low	A lot
Energy production time	Very short (1-10 seconds)	Short (45''– 9 min)	Long (minutes – hours)
Intensity of effort	Very intense (VO^{2max})	Intense (80-90% VO^{2max})	Moderate – Low (50-80% VO^{2max})
Type of exercise or sport	Running 100m, jumping, throwing	Runs 200 - 3000m	5000m races – marathon
Type of muscle fiber	Fast type II B	Fast type II A	Slow type I
Metabolic toxicity	No	Yes. Muscle acidosis.	No

VO^{2max}= maximum oxygen volume; % percentage; min= minutes; m= meters; ”= seconds

Competitive team handball, as most of the field and court team sports (i.e., soccer, rugby, basketball, and futsal, resp.), is a high-demanding intermittent exercise that primarily uses the aerobic metabolism, interspersed by high-intensity actions that greatly tax the anaerobic pathway due to numerous high-intensity movements and actions that occur throughout the game (Cardinale et al., 2017; Karcher & Buchheit, 2014). The relative workload during the matches is 65–80% of VO2max, the total distance covered per match ranges from 2.600 to 4.700 m (Manchado et al., 2020, 2021), consisting mostly of walking and jogging (~70% of match time), heart rate mean (HRmean) is 80% HRmax, a high number of activities changes (600–1500 per match), and a post-match blood lactate of 3–11 mM (mmol) was reported. The activity profile differs across playing positions (Cardinale et al., 2017; Karcher & Buchheit, 2014;Manchado et al., 2021; Póvoas et al., 2014) and competitive level (Haugen, Tønnessen, & Seiler, 2016) and neuromuscular fatigue occurs throughout the game (Michalsik et al., 2013; Michalsik et al., 2015; Póvoas et al., 2014).

2. CHARACTERISTICS OF A HEALTHY DIET

- Satisfactory: pleasant and sensorially pleasing.
- Sufficient: covers energy needs.
- Complete: contains all the nutrients that the body needs and in adequate amounts.
- Balanced: including a wide variety of fresh foods of mainly vegetable origin, and with little or no presence of alcoholic beverages or foods of low nutritional quality.
- Safe: does not contain dangerous amounts of harmful substances or pathogens.
- Adapted: adapts to physiological, geographical, social, religious, and cultural characteristics.
- Sustainable: lowest possible impact on climate change and prioritizes local products.

3. ENERGY RECOMMENDATIONS

Table 2. Daily energy needs (Kcal/day) by age and sex.

Physical activity	Subjects	Male	Female
Physical activity-light	JUNIOR (≤ 19 years)	1800	1600
	SENIOR (≥ 20 years)	2800	2400
Physical activity-moderate	JUNIOR (≤ 19 years)	2500	2200
	SENIOR (≥ 20 years)	3800	3400
Physical activity-intense	JUNIOR (≤ 19 years)	3000	2700
	SENIOR (≥ 20 years)	4900	4200

**Based on an energy expenditure estimation, which may vary widely depending on lifestyle and training characteristics. Light = rest day; Moderate = short duration and intensity training (<30min); Intense = Training lasting over 1 hour*

Table 3. Carbohydrate, protein, and fat recommendations by age and sex depending on the intensity of physical activity.

			kcal/day				Percentage		
Physical activity			Total	CH	Proteins	Fats	CH	Protein	Fat
Physical activity-light	JUNIOR	Male	1800	910	308	582	50.6	17.1	32.3
		Female	1600	825	264	511	51.6	16.5	31.9
	SENIOR	Male	2800	1428	612	760	51.0	21.9	27.1
		Female	2400	1216	448	736.0	50.7	18.7	30.7
Physical activity-moderate	JUNIOR	Male	2500	1400	392	708	56.0	15.7	28.3
		Female	2200	1200	336	664	54.5	15.3	30.2
	SENIOR	Male	3800	2040	680	1080	53.7	17.9	28.4
		Female	3400	1760	640	1000	51.8	18.8	29.4
Physical activity-intense	JUNIOR	Male	3000	1610	490	900	53.7	16.3	30.0
		Female	2700	1440	360	900	53.3	13.3	33.3
	SENIOR	Male	4900	2720	952	1228	55.5	19.4	25.1
		Female	4200	2240	704	1256	53.3	16.8	29.9

CH: Carbohydrates; Junior ≤ 19 years; Senior ≥ 20 years

4. DIETARY–NUTRITIONAL RECOMMENDATIONS FOR HANDBALL TRAINING AND COMPETITION

4.1. Macronutrient recommendations

Table 4. g/day of carbohydrates, fats, and protein according to age and sex.

			Carbohydrates (g/day)	Fat (g/day)	Protein (g/day)
Physical activity-light	JUNIOR	Male	227,5	64	77
		Female	165	60	66
	SENIOR	Male	357	85	153
		Female	304	80	112
Physical activity-moderate	JUNIOR	Male	350	80	98
		Female	300	73	84
	SENIOR	Male	510	120	170
		Female	440	111	160
Physical activity-intense	JUNIOR	Male	402.5	100	122.5
		Female	360	100	90
	SENIOR	Male	680	135	238
		Female	560	140	176

**Based on an energy expenditure estimation, which vary widely depending on lifestyle and training characteristics. Light= rest day; Moderate= Short duration and intensity training (<30min); Intense= Training lasting over 1 hour. Junior ≤ 19 years; Senior ≥ 20 years*

4.2. MACRONUTRIENTS

CARBOHYDRATES

This macronutrient is the greatest source of fast energy for the organism and the main source of energy during moderate or high intensity exercise. Its availability will be a limiting factor; therefore, it must be replaced every day.

Carbohydrates help the recovery of normal muscle function (contraction) after highly intensive and/or long-lasting physical exercise, leading to muscle fatigue and the depletion of glycogen stores in the skeletal muscle. In addition, Carbohydrates are responsible to maintain normal brain function because they are a key fuel for the brain and central nervous system.

Carbohydrate stores in the body are limited, being reduced to hepatic and muscular glycogen. This storage is limited, once exceeded, the glucose is transformed into fat and stored in fat or adipose tissue. Although, constant training can double the storage capacity in the muscle. Therefore, it will be a key objective for the athlete to consume enough carbohydrates to ensure a positive glycogen balance. A daily carbohydrate intake of 6 to 10 g/kg body weight is recommended, which may vary depending on the intensity and duration of training (Thomas et al., 2016).

Another important factor is the relationship with protein intake: a carbohydrate: protein ratio of 3:1 and 4:1 can improve performance, minimize muscle damage, and facilitate maximum replenishment of muscle glycogen stores in endurance sports (Burke et al., 2011; Thomas et al., 2016).

Sources

Cereals, grains, derivatives – portion 50-100g (dry)

Tubers – portion 200 – 250g (one medium-sized unit)

Whole meal bread – portion 30 – 80g (one medium-sized unit)

Vegetables – portion 150 – 200g

Fruit – portion: 150 – 200g

Based on various scientific bibliography, the following guidelines for carbohydrate consumption in relation to physical activity are proposed in the following table 5 and figure 1:

Table 5. Carbohydrate intake before, during and after physical activity (Thomas et al., 2016).

Before exercise (To increase CH availability)		
• 1-4 g/kg body weight (1-4 hours before).		
• Foods low in fat and fiber, well tolerated.		
During exercise		
Exercises of less than 45 minutes duration.	Endurance exercise.	Ultra-endurance exercise. More than 2.5-3 hours.
	Between 1-2.5 hours.	
30-60 g CH/hour	30-60 g CH/hour	60-90 g CH/hour
After exercise (Rapid post-exercise recovery)		
• 1-1.2 g/kg body weight/hour just post-exercise until the first 4 hours.		
• CH in small amounts every 15-60 minutes.		

CH= carbohydrates; g= grams

• 2 slices sliced bread (60g) • 3 tablespoons honey (66g) • 1 medium banana (170g)	• 1 glass of rice drink (225g) • 1 tablespoon honey (45g) • 20g raisins • 4 tablespoons oatmeal (60g)	• Banana Smoothie (rice drink, banana, oatmeal, oatmeal, honey) • Bread toast (30g) • 1 egg	• 2 cups of macaroni (100g) • Crushed tomato (60g) • 1 medium banana (170g)

Figure 1. Options of pre-event meals providing approximately 100g carbohydrate.

PROTEINS

Among all the nutrients, protein intake is perhaps the most controversial in sports nutrition (Thomas et al., 2016; Kerksick et al., 2018). An adequate protein intake, if the energy intake is sufficient, will fulfill the following missions:

1. Repair the body's cells
2. Allows an adequate synthesis of muscle mass
3. Maintenance of normal bones
4. Increases strength
5. Improves post-exercise recovery
6. Improves the response of the immune system
7. Reduces the likelihood of musculoskeletal injuries

The protein requirements of athletes are increased with respect to the normal population, to compensate for the increased muscle breakdown that occurs during and after intense exercise, as well as to build new muscle cells. Although, there is no consensus on the amount of protein that should be provide to them (Thomas et al., 2016; Kerksick et al., 2018).

Some options are:

- 1.2-1.4 g/ kg body weight (bw)/day for aerobic endurance athletes.
- 1.2-1.7 g/kg bw/day for athletes with predominantly strength training.
- 1.5-2 g/kg body weight/day for endurance athletes.
- 2-3 g/ kg bw/day for athletes undergoing strength training.

Of course, all these recommendations will be modified within a range, depending on the composition of the diet, total energy intake, intensity and duration of exercise, training, temperature, sex, and age. Proteins can be used as an energy substrate in cases of emergency. Figure 2 shows an example of dietary planning that provides 127 g of protein

Intake	Food	Grams (g) of protein
Breakfast	2 eggs on multigrain toast	20g protein
Snack	Protein liquid yoghurt	25g protein
Lunch	Tuna (60g) and quinoa (50g) salad	22g protein
Snack	Handful nuts (30g)	6g protein
Dinner	Veggies and steak (150g) with potatoes	39g protein
Pre-bed	150g protein yoghurt	15g protein

Figure 2. Menu proposal with 127g of protein (1.8 g/kg bw/day for an athlete approximately 70 kg). g= grams

Sources

Meats – portion: 100 – 150g appr.
(1 breast, ¼ chicken, 1 steak, 3-4 loin slices)

Eggs – portion: 1 - 2 units

Fish – portions: 120 – 140g appr.
(1 medium sea bream, 2 – 3 hake slices, 1 salmon fillet, 1 bass)

Vegetables – portion: 150 – 200g cooked / 60-80g dry

Dairy products – portion: 1 yoghurt, 30 – 40g cured or semi-cured

FAT

Important macronutrient that provides energy and essential cell membrane elements, as well as vitamins A, D, K and E (fat soluble vitamins). Lipid intake should be like that of a usual diet: predominance of monounsaturated, followed in equal measure by polyunsaturated (especially omega-3 and saturated).

Between 20-35% of the calories in our diet should come from fat. The distribution of fatty acid families should be like the usual diet: predominance of monounsaturated, followed in equal proportion by polyunsaturated (especially omega-3 and saturated). Not less than 15% of total calories should be ingested, to ensure the supply of essential fatty acids and fat-soluble vitamins.

In the context of performance, it is important to know that short-chain fatty acids are digested faster than long-chain fatty acids and are available for energy (Thomas et al., 2016).
Found in olive oil, which provides healthy fats such as monounsaturated fats; nuts, such as almonds or nuts, with some fats rich in omega 3; and blue fish, such as salmon, sardines, or mackerel.

Sources

Extra virgin olive oil - Portion: 1-2 spoons/ 4-6 times a day

Avocado - Portion: ½ medium unit or 1 small unit

Nuts and seeds - Portion: a handful, 30-40g aprox.

4.3. MICRONUTRIENTS

VITAMINS AND MINERALS

An adequate intake of these micronutrients is essential for athletes for the following reasons (Thomas et al., 2016; Kerksick et al., 2018):

- They are important metabolic regulators, so they play a fundamental role in energy production during effort
- They participate in the synthesis of hemoglobin
- They participate in the maintenance of bone health
- They participate in the maintenance of immune function
- They have a protective effect against oxidative damage
- They play an important role in the synthesis and repair of muscle tissue during post-exercise or injury recovery

Table 6. Recommended daily intake of micronutrients for children and teenagers.

Element	Units	RDI children (1-9 years)	RDI Male-teenagers (10-19 years)	RDI Female-teenagers (10-19 years)
Sodium	(mg)	1500	1500	1500
Calcium	(mg)	800	1300	1300
Manganese	(mg)	1,5	2,2	1,6
Copper	(µg)	440	890	890
Selenium	(µg)	30	55	55
Magnesium	(mg)	130	410	360
Chromium	(µg)	15	35	24
Iron	(mg)	10	11	15
Zinc	(mg)	5	11	9
Fluorine	(mg)	1	3	3
Phosphorus	(mg)	500	1250	1250
Molybdenum	(µg)	22	43	43
Potassium	(mg)	100	3500	3500
Iodine	(µg)	90	150	150
		Free-soluble vitamins		
A	(µg)	400	900	700
D	(µg)	5	5	5
E	(µg)	7	15	15
K	(µg)	55	75	75
		Water soluble vitamins		
Vit. C	(mg)	25	75	65
Thiamine	(mg)	0,6	1,2	1
Riboflavin	(mg)	0,6	1,3	1
Niacin	(mg)	8	16	14
Vit.B	(mg)	0,6	1,3	1,3
Folate	(mg)	200	400	400

Vit.B12	(µg)	1.2	2.4	2.4
Pantothenic acid	(µg)	3	5	5
Biotin	(µg)	12	25	25
Choline	(mg)	250	550	400

RDI= daily reference intake; mg= milligrams; µg= micrograms

Table 7. Recommended daily intake of micronutrients for adults.

Element	Unit	RDI Male (> 20 years)	RDI Female (> 20 years)
Sodium	(mg)	1500	1500
Calcium	(mg)	2300	1800
Manganese	(mg)	2.3	1.8
Copper	(µg)	55	55
Selenium	(µg)	400	330
Magnesium	(mg)	420	320
Chromium	(µg)	10	18
Iron	(mg)	11	8
Zinc	(mg)	1000	1200
Fluorine	(mg)	4	3
Phosphorus	(mg)	700	1200
Molybdenum	(µg)	45	45
Potassium	(mg)	3500	3500
Iodine	(µg)	150	150
		Free-soluble vitamins	
A	(µg)	900	700
D	(µg)	5	5
E	(µg)	15	15
K	(µg)	120	90
		Water soluble vitamins	
Vit. C	(mg)	90	75
Thiamine	(mg)	1.2	1.1
Riboflavin	(mg)	1.3	1.1
Niacin	(mg)	16	14
Vit.B	(mg)	1.3	1.3
Folate	(mg)	400	400
Vit.B12	(µg)	2,4	2.4
Pantothenic acid	(µg)	5	5
Biotin	(µg)	30	30
Choline	(mg)	550	425

RDI= daily reference intake; mg= milligrams; µg= micrograms

5. HYDRATION

Good hydration is a fundamental condition for optimizing sports performance. The importance of liquids, water and sports drinks (isotonic drinks and recovery drinks) lies in the restoration of the body's homeostasis due to the loss of water and electrolytes (ions) caused by physical activity through mechanisms such as sweating (Martínez Sanz, Urdampilleta Otegui, & Mielgo Ayuso, 2013). During physical activity, sweating is essential for optimal thermoregulation. Therefore, in addition to the recommendations of consuming 1.5-2 litres/day of water, the physically active person should ingest 150% of what is lost through sweating. This loss can vary between 0.4 and 1.5 l/hour, depending on environmental conditions, degree of training, etc. The drink should contain between 4 and 8% carbohydrates and electrolytes, especially in efforts lasting more than one hour and at high temperatures (Martinez Sanz et al., 2013).

- It is important to be well hydrated before starting the activity and to minimize dehydration.
- Good hydration is a fundamental condition for optimizing sports performance.
- During physical activity, sweating is essential for optimal thermoregulation.
- Liquids, water, and sports drinks (isotonic drinks and recovery drinks) are important to restore the body's homeostasis due to loss of water and electrolytes (ions) caused by physical activity through mechanisms such as sweating.
- Liquids can be taken during match or training breaks, and when switching exercises during training

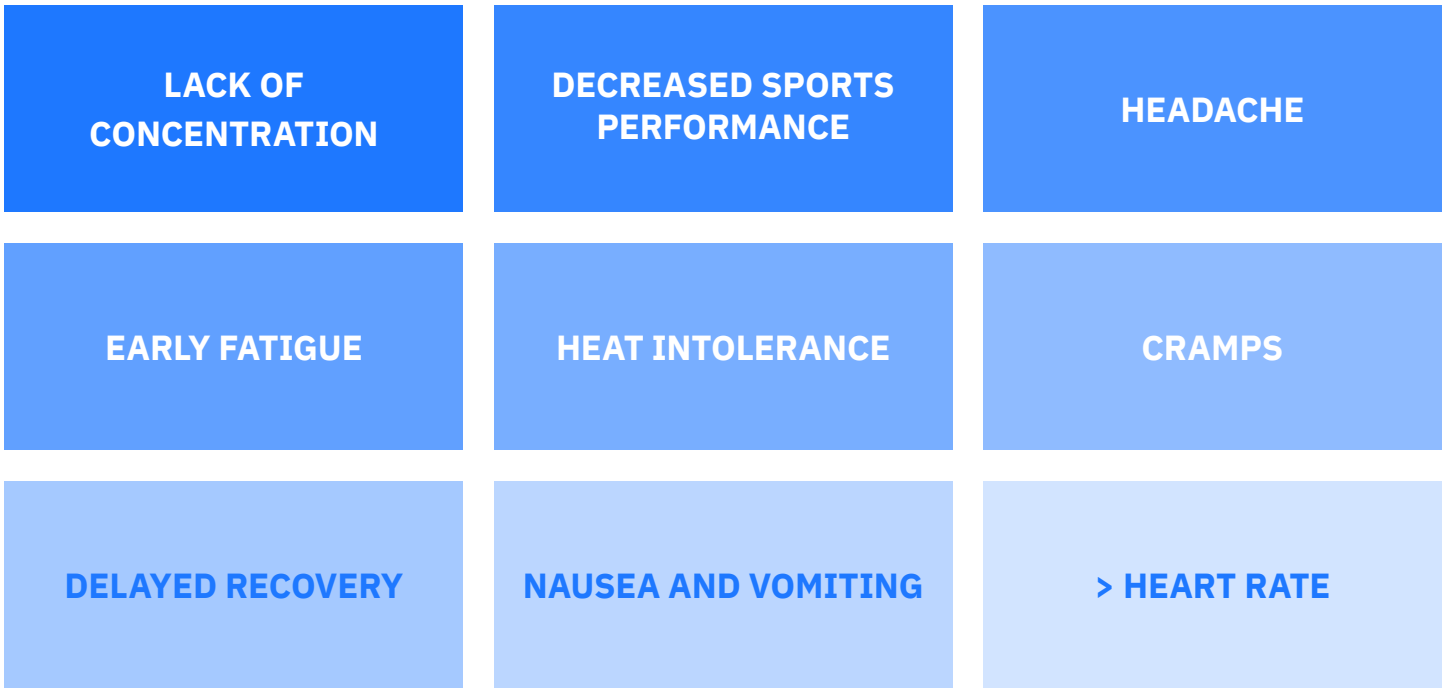


Figure 3. Dehydration signs and symptoms.

5.1. HYDRATION RECOMMENDATIONS

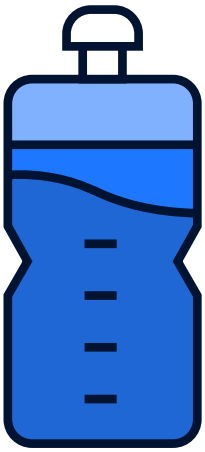
BEFORE	DURING	AFTER
Start training or competition in a state of euhydration	Replenish sweat losses	Do not compromise subsequent sessions or competitions
Objective: delay fatigue	Avoiding peformance losses due to dehydration	Pure water = hyponatremia; lowered osmolarity
Fluid requirements increase with increasing ambient temperature and intensity	Maintain water and electrolyte balance	REPLENISMENT DRINKS: Carbohydrates to simulate the absorption od liquids in the intestine
Hot and humid environments consume 0.5l of water with salts during the previous hour	There is no standard protocol	Intracellular rehydration by muscle absorption and glycogen resynthesis

Figure 4. Hydration objectives before, during and after.

BEFORE	DURING	AFTER
5 to 7 ml/kg during the 4 hours prior to exercise.	15-20' between 150-250ml of isotonic drink containing a 6-9% combination of various sugars (glucose, sucrose, maltodextrin and fructose). Ensure an intake of 0.5-0.7g Na+/l.	**150%** of sweat loss minimum: 1.5 l/kg weight lost Na+ supply between 1-1.5 g/l **Sweating rate**.

Figure 5. Summary of hydration protocol before, during and after.

5.2. WHAT IS A SPORTS DRINK?



WATER

CARBOHYDRATES

ELECTROLYTES

Sodium: 460-1150 mg/L
Potassium: 195 mg/L

Figure 6. Characteristics of isotonic drinks.

Table 8. Characteristics of sports drinks.

	Minimum	Maximum	Remarks
Kcal/L	80	350	
Volume (ml)	500	1000	Reduce intake to a minimum as mobilisation increases.
Sugars (%)	6	9	In the case of handball matches and training, hydration during the match is sometimes difficult due to the game's intensity, so high carbohydrate content is important.
Sugar types	Maximum optimisation with a mixture of fast sugars, glucose, maltodextrin, and of slow absorption, fructose, respecting a 3/1 ratio. Fructose should not exceed 33% of total sugars.		
Na+ (g/L)	0.46	1.20	The proportion of sodium should be increased to avoid hyponatremia, especially in extreme environmental conditions (cold, heat, humidity). With heat acclimatization, a lower loss of salts can be achieved.
Osmolarity (mOsm/L)	200	300	
Temperature (ºC)	10	20	

L= liters, mL= milliliters, %= percentage; g= grams, mOsm= osmol per liter; ºC=grades

5.3. HYDRATION IN CHILDREN

- Children have a higher ratio of body surface area to body mass (at the age of 8 years it is approximately 50% higher than that of an adult).
- It has been suggested that children who exercise should be able to lower heat faster than adults.

Figure 7. Adequate hydration diagram.

6. HOW TO TRANSLATE THIS INFORMATION INTO DAILY PRACTICE?

6.1. HEALTHY MEALS

Figures 8-10 show how the composition of the main intakes should be according to the type of training (Reguant-Closa et al., 2019).

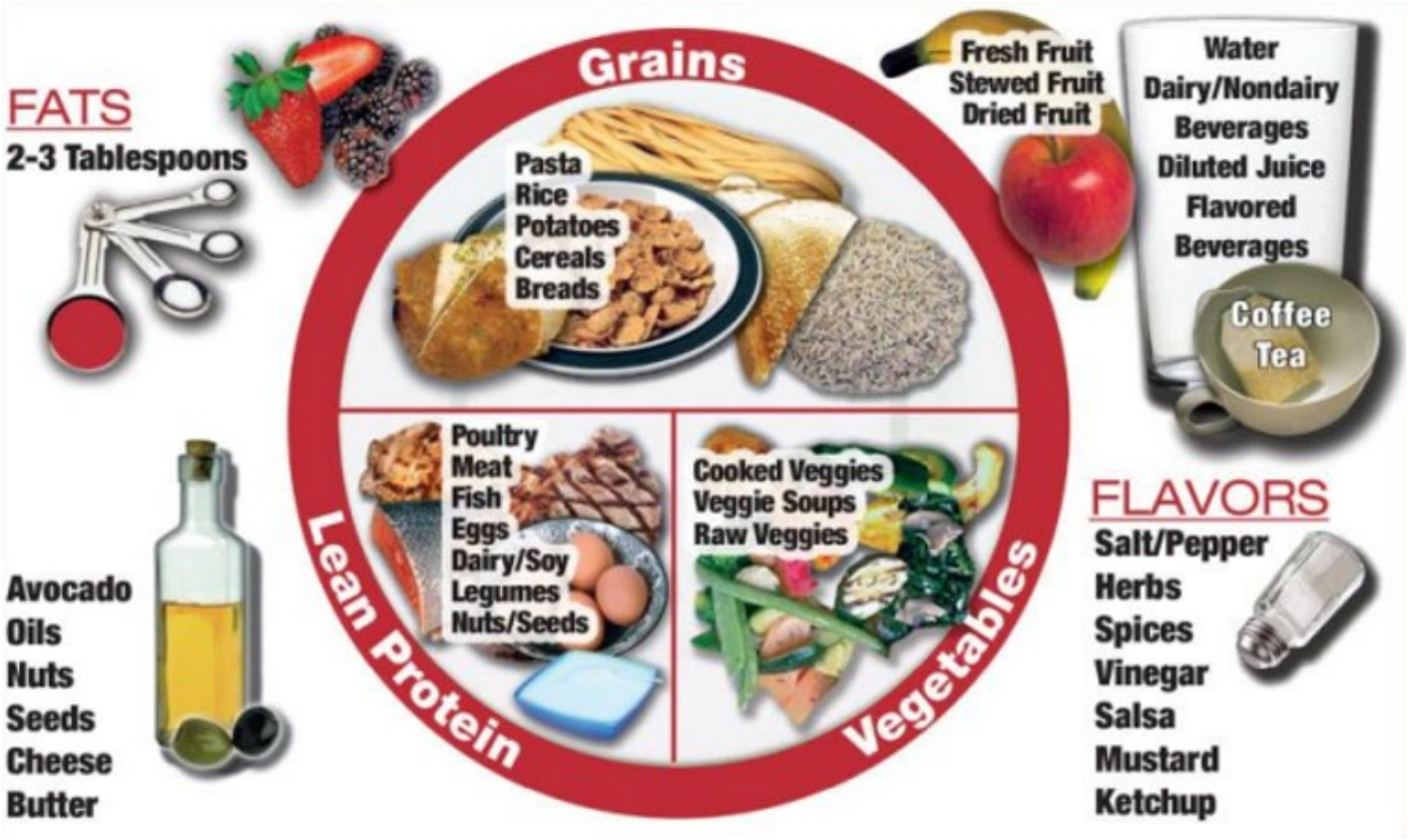


Figure 8. Hard training or match day. Source: Reguant-Closa et al., 2019.

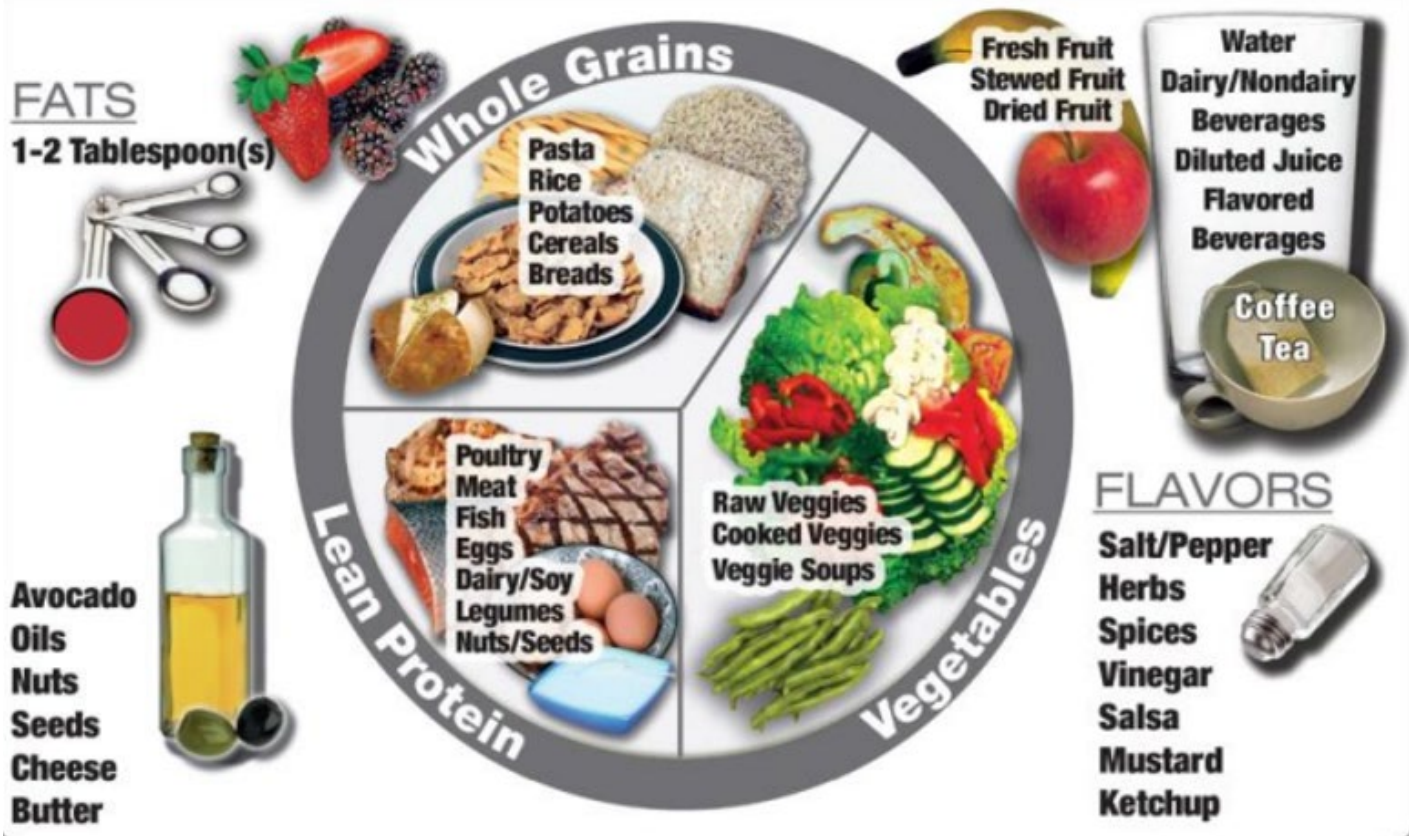


Figure 9. Moderate training. Source: Reguant-Closa et al., 2019.

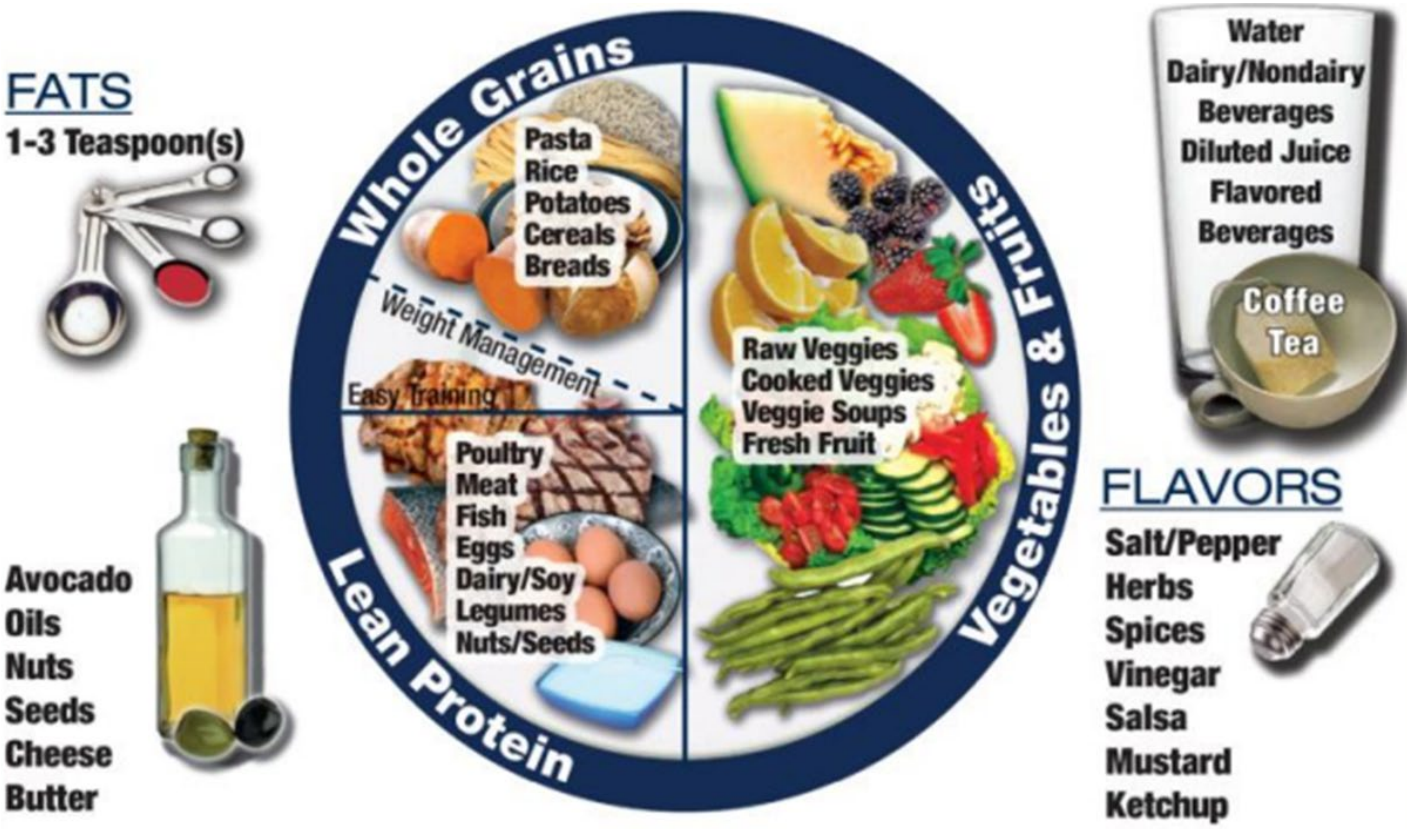


Figure 10. Easy training. Source: Reguant-Closa et al., 2019.

6.2. HEALTHY MEALS FOR HANDBALL PLAYERS

EXAMPLES OF ADEQUATE INTAKES FOR HANDBALL PLAYERS

Table 9. Proposals for breakfast and snacks for basketball players.

BREAKFAST	
OPTION 1	**OPTION 2**
Whole wheat toast Tuna / ham / serrano ham Fruit or juice	Yoghurt + protein yoghurt Cereals Fruit
SNACK	
OPTION 1	**OPTION 2**
1 protein yoghurt drink 3 cereal bars 1 banana	Whole wheat bread with tomatoes Tuna + fresh cheese / jamon serrano with tomatoes / turkey Fruit
OPTION 3	**OPTION 4**
1 protein yoghurt drink Cereals 1 banana	Whole wheat bread Tuna + fresh cheese / jamon serrano with tomatoes / turkey Fruit

Table 10. Proposed lunch organisation.

LUNCH (choose one food from each group)			
VEGETABLES	**CARBOHYDRATES**	**PROTEIN**	**DESSERT**
Salad	White/Brown rice	Meat	Fruit
Cold vegetable soup	Boiled pasta	Fish	
Vegetable cream	Whole wheat pasta	Eggs	
	Boiled / oven potatoes		

Table 11. Proposed dinner organisation.

DINNER (choose one food from each group)			
VEGETABLES	**CARBOHYDRATES**	**PROTEIN**	**DESSERT**
Salad	White rice	Meat	Yoghurt
Cold vegetable soup	Brown rice	Fish	
Vegetable cream	Boiled / oven potatoes	Eggs	

DIETARY AND NUTRITIONAL PLANNING EXAMPLE

Table 12. Dietary and nutritional planning. Male 90kg, physical activity light.

BREAKFAST	200ml glass of semi-skimmed milk with 30g cornflakes
	50g white bread + 30g cooked ham + 10g extra virgin olive oil
SNACK 1	200ml orange juice
	50g white bread + 20g cured pork loin + 10g extra virgin olive oil
LUNCH	100g white pasta salad + 200g white fish + 200g potato + 10g extra virgin olive oil
	1 fruit with 1 yoghurt
SNACK 2	1 fruit
	50g white bread + 30g boiled ham + 10g extra virgin olive oil
DINNER	100g white rice with tomato sauce + 2 eggs + 160g chicken breast + 200g broccoli + 10g extra virgin olive oil
	1 fruit with 1 yoghurt

g= grams

Table 13. Dietary and nutritional planning. Female 65kg, physical activity light.

BREAKFAST	200ml oat drink with cocoa powder (1 tablespoon)
	30g white bread + 30g cheese + 10g extra virgin olive oil
SNACK 1	50g white bread + 20g cured pork loin + 10g extra virgin olive oil
LUNCH	Rice 3 Delicious (70g rice + 1 egg + 30g cooked ham + 100g of vegetables (carrot and peas) + 10g extra virgin olive oil)
	1 fruit
SNACK 2	1 fruit
	1 yoghurt + a handful of nuts
DINNER	150g cooked potatoes + 200g of vegetables (broccoli, tomato, onion) + 150g white fish + 10g extra virgin olive oil
	1 fruit

DIETETIC-NUTRITIONAL PLANNING FOR TRAINING

Depending on the type of training, the intensity and duration will be different, therefore the amount and type of food to be ingested will also be different. The following tables present examples for both male (table 14) and female (table 15).

Table 14. Caloric expenditure in males according to training and time.

Type of training	Time of activity	kcal (20 years - 183 cm - 84,01 kg)	kcal (14 years - 175 cm - 66,77 kg)	Substratum
Stretching	30 min	100 kcal	100 kcal	
Regenerative	30 min 1 hour	300 kcal 500 kcal	240 kcal 400 kcal	Carbohydrates
Aerobic	1 hour 2 hours	500 kcal 900 kcal	400 kcal 700 kcal	Carbohydrates, fats, amino acids
Resistance	1 hour 2 hours	600 kcal 1200 kcal	500 kcal 1000 kcal	Carbohydrates
Mixed	1 hour 2 hours	700 kcal 1300 kcal	500 kcal 1000 kcal	Carbohydrates, ATP, Phosphocreatine
Handball training (mixed specific)	30 min 1 hour 2 hours	400 kcal 800 kcal 1400 kcal	300 kcal 600 kcal 1100 kcal	Carbohydrates, ATP, Phosphocreatine

min= minutes; kcal= kilocalories; ATP = adenosine triphosphate

It should be noted that when talking about performance in female athletes, it is important to consider the menstrual cycle and hormone concentration. Serum concentrations of luteinizing hormone (LH), follicle-stimulation hormone (FSH), estradiol (E2) and progesterone (Prog) fluctuate during the menstrual cycle and that the level of androstenedione and testosterone reaches its peak prior to, or at the time of ovulation. This fluctuation of hormones during the menstrual cycle may influence 1) acute exercise performance during the respective phase, 2) muscle strength training capacity, and 3) nutritional needs and concerns (Rossi, 2017). When it has been studied how food consumption varies, it has been observed that the desire to consume foods rich in sugar, salt and fat, such as chocolate, cakes, snacks and desserts is higher in the premenstrual period (Souza et al., 2018). Energy expenditure increases after ovulation. This increase is due to progesterone from the corpus luteum, there is an increase of approximately 9% in 24h (Webb, 1986). Energy expenditure during sleep is greater in the postovulatory stage than in the days prior to ovulation. Therefore, due to that variation in energy expenditure, the menstrual cycle affects appetite (Brennan et al., 2009; Hintze, Mahmoodianfard, Auguste, & Doucet, 2017).

Table 15. Caloric expenditure in females according to training and time.

Type of training	Time of activity	kcal 20 years - 175 cm - 70 kg	kcal 14 years - 165 cm - 61,1 kg	Substratum
Stretching	30 min	100 kcal	100 kcal	Carbohydrates
Regenerative	30 min 1 hour	170 kcal 280 kcal	150 kcal 250 kcal	Carbohydrates, fats, amino acids
Aerobic	1 hour 2 hours	400 kcal 750 kcal	370 kcal 680 kcal	Carbohydrates
Resistance	1 hour 2 hours	480 kcal 905 kcal	430 kcal 800 kcal	Carbohydrates, ATP, Phosphocreatine
Mixed	1 hour 2 hours	555 kcal 1100 kcal	490 kcal 930 kcal	Carbohydrates, ATP, Phosphocreatine
Handball training (mixed specific)	30 min 1 hour 2 hours	340 kcal 625 kcal 1200 kcal	300 kcal 550 kcal 1050 kcal	Carbohydrates

min= minutes; ATP = adenosine triphosphate

After each of the training sessions, a specific intake should be made. Different examples of post workouts suitable for each of the workouts are presented in table 16:

Table 16. Example of post-training meals

AEROBIC
• 200 kcal = smoothie (200g fruit + 15g cereals + 120g milk + 10g nuts)
• 400 kcal = 200ml soy beverage + 55g granola + 10g nuts
• 600 kcal = 130g bread + 150g egg whites + 150g turkey + 10g olive oil
• 800 kcal = crepes (200g egg whites + 110g oatmeal + 10g olive oil) + 95g ham
RESISTANCE
• 400 kcal = 32g protein powder + 45g oat flakes (or ground oats) + 10g nuts + 5g creatine
• 500 kcal = oat pancakes (40g oatmeal + 200mL egg whites + 5g olive oil) + 120g turkey breast + 7g dried fruits and nuts
• 600 kcal = 400ml milk + 20g cereals + 120g tuna + 40g bread + 15g nuts
• 900 kcal = sandwich (60g bread + 100g pork loin + 300g egg white + 10g olive oil) + smoothie (200mL milk + 1 banana)
MIXED
• 400 kcal = 180g whipped cream cheese + 50g cereals + 10g walnuts
• 450 kcal = 32g protein powder + 60g oat flakes (or ground oats) + 1 medium banana (170g)
• 600 kcal = 75g cereal + 400mL semi-skimmed milk + 10g cocoa powder
• 1000 kcal = Yoghurt with cereals (500g whipped cream cheese + 50g cereals + 10g dried fruits) and sandwich (80g rye bread + 180g tuna in oil)

7. NUTRITIONAL GUIDELINES BEFORE, DURING AND AFTER A MATCH

7.1. Nutritional guidelines before match

- Foods with higher amounts of fat, protein, and fiber, as well as large volumes of these foods, take longer to be digested than other foods, and may increase the risk of gastrointestinal discomfort.
- Recommended intake is between 50-150g (1-2 g/kg body weight) of carbohydrates during the 1-2 hours prior to increasing pre-exercise muscle glycogen levels.
- Recommended fluid intake is 5-7 ml /kg 4 hours before exercise (A 65kg person would consume 455ml). Drink with carbohydrates that provide sustained energy and sodium that stimulates thirst and helps water absorption.

Table 17. Recommended ingredients for previous intake

FOOD GROUPS
Dairy or vegetable drinks
Tubers
Fatty foods

Table 18. Options of pre-event meals providing approximately 100g carbohydrates

• 2 slices bread (60g)	• 1 glass of rice drink (225g)	• Banana smoothie (rice drink, banana, oatmeal, honey)	• 2 cups of macaroni (100g)
• 3 tablespoons honey (66g)	• 1 tablespoon honey (45g)	• Bread toast (30g)	• Crushed tomato (60g)
• 1 medium banana (179g)	• 20g raisins	• 1 egg	• 1 medium banana (170g)
	• 4 tablespoons oatmeal (60g)		

PRE-EXERCISE MEALS AND SNACKS

Examples of intakes 3-4 hours before the match.

The intake proposals in this section should not be considered as a daily menu, but rather as a punctual intake proposal at different times depending on the moment of the match (morning or afternoon).

Table 19. Breakfast options (if the match is before lunch)

	Ingredients	Nutritional information	Special recommendations
Option 1	A cup of skimmed milk (200ml) with 2 tablespoons of cocoa powder (20g) Corn flakes (60g) Fresh orange juice (200ml) Toasted white bread (60g) Jam (25g)	Energy: 640 kcal Carbohydrates: 133 g Protein: 20 g Fat: 3 g Fiber: 5.5 g	Woman and child: use 30g of cornflakes and 1 tablespoon of cocoa powder.
Option 2	A cup of skimmed milk (200ml) with cocoa powder (20g) 8 plain “Maria” biscuits (45g) Toasted white bread (60g) with low-fat fresh cheese (40g) and jam (40g) A large banana (200g)	Energy: 900 kcal Carbohydrates: 160 g Protein: 26 g Fat: 12 g Fiber: 8.2 g	Woman and child: use 1 tablespoon of cocoa powder, do not have the plain “Maria” biscuits, use 60g of toasted white bread and a standard banana (120g).
Option 3	Two skimmed yogurts with fruit (250g) and jam (50g) Oat flakes (50g) Corn flakes (50g) A large banana (200g) Toasted white bread (50g) with ham (40g)	Energy: 1000 kcal Carbohydrates: 192 g Protein: 38 g Fat: 8 g Fiber: 16 g	Woman and child: use half a serving of cereals (30g of oat or corn flakes) and jam (25g) and have a standard banana (120g).
Option 4	Skim milkshake (300ml) with a large banana (200g), strawberries (150g), two tablespoons of sugar (20g), add oat flakes (50g) and corn flakes (50g) Toasted white bread (60g) with low-fat fresh cheese (60g) and jam (50g)	Energy: 116 kcal Carbohydrates: 225 g Protein: 38 g Fat: 7 g Fiber: 18 g	Woman and child: use half a serving of cereals (30g of oat or cornflakes), a standard banana (120g) and ½ dose of strawberries (75g), do not add the tablespoons of sugar and jam.

** Dietetic-nutritional estimates for the following weights: 65 kg for females, 70 kg for males and 55 kg for children. The proposals have been adapted to the dietary-nutritional recommendations made for athletes. It is recommended to consume the proposed foods at the indicated times. The food proposals must be tested before training to ensure the athlete’s safety regarding food tolerance. Skimmed milk prior to training or a match is useful because of its low-fat content and because it reduces possible adverse effects (gastrointestinal problems). In general, a daily consumption of semi-skimmed or whole milk is recommended because it provides vitamin D which helps to absorb calcium.*

Table 20. Lunch options (if the match is after lunch)

	Ingredients	Nutritional information	Adaptations
Option 1	Puree of a large potato (250g) with whiting (125g) and toasted bread (40g) Spaghetti (120g) sautéed with prawns (30g), mushrooms (40g) and a tablespoon of olive oil (10g) 1 serving of rice pudding (125g)	Energy: 1048 kcal Carbohydrates: 167 g Protein: 55.5 g Fat: 17 g Fiber: 13 g	Woman and child: do not add the rice pudding and use 80g of spaghetti.
Option 2	White rice (100g) with peas (50g), corn (40g), grilled chicken breast (100g) White bread (50g) and a tablespoon of olive oil (10g) Skimmed yogurt with fruit (125g) with a tablespoon of jam (10g), 4 tablespoons of cornflakes (40g), and a large banana (200g)	Energy: 1132 kcal Carbohydrates: 198.5 g Protein: 47 g Fat: 16.5 g Fiber: 16 g	Woman and child: use ½ dose of rice (50g) and a standard banana (120g). Do not add cornflakes and jam.
Option 3	Pasta salad (90g) with potato (200g), a hard-boiled egg, corn (50g), turkey breast (100g) and a tablespoon of olive oil (10g) White bread (60g) Apple compote (150g) A medium banana (150g)	Energy: 1248 kcal Carbohydrates: 192 g Protein: 54 g Fat: 22 g Fiber: 17 g	Woman and child: Do not add a sports drink glass or a fruit (apple compote and medium banana).

** Dietetic-nutritional estimates for the following weights: 65 kg for females, 70 kg for males and 55 kg for children. The proposals have been adapted to the dietary-nutritional recommendations made for athletes. It is recommended to consume the proposed foods at the indicated times. The food proposals must be tested before training to ensure the athlete's safety regarding food tolerance.*

The food proposals in this section should not be considered as a daily menu, but rather as a specific food proposal for one or two hours prior to the match.

Table 21. Examples of snacks for 2 hours before exercise.

	Ingredients	Nutritional information	Adaptations
Option 1	Sandwich (60g of white bread) with 6 slices of pork loin cold cuts (50g) 140g of strawberries (8 units) and 3 tablespoons of oat flakes (30g)	Energy: 371 kcal Carbohydrates: 53 g Protein: 27 g Fat: 5.5 g Fiber: 7 g	Male: add 2 tablespoons of oat flakes (20g) more and a standard banana unit (120g).
Option 2	Homemade shake: a glass of sweetened natural liquid yogurt (150g), 120g of strawberries (7 units), a unit of small banana (100g), 2 tablespoons of cornflakes (20g) and 2 tablespoons of jam (20g)	Energy: 354 kcal Carbohydrates: 75 g Protein: 8 g Fat: 3 g Fiber: 5 g	Male: use a large unit of banana and a tablespoon of corn flakes (10g).
Option 3	A sandwich (80g of white bread) with a can of natural tuna (80g) A glass of sports drink (200ml) A natural skimmed yogurt (125g) with 2 tablespoons of honey (20g) and a large unit of peeled pear (230g)	Energy: 541.5 kcal Carbohydrates: 96 g Protein: 33 g Fat: 3 g Fiber: 8 g	
Option 4	Sandwich (58g of sliced bread) with low-fat fresh cheese (45g) and 3 tablespoons of jam (30g) skimmed yogurt with fruit (125g) with 4 tablespoons of cornflakes (40g), a medium banana (150g) and 6 strawberries (100g)	Energy: 603 kcal Carbohydrates: 125 g Protein: 18 g Fat: 3.5 g Fiber: 10.5 g	

** Dietetic-nutritional estimates for the following weights: 65 kg for females, 70 kg for males and 55 kg for child. The proposals have been adapted to the dietary-nutritional recommendations made for athletes. It is recommended to consume the proposed foods at the indicated times. The food proposals must be tested before training to ensure the athlete's safety regarding food tolerance. The use of skimmed milk prior to training or a match is useful due to its low-fat content and because it reduces possible adverse effects (gastrointestinal problems). In general, the daily consumption of semi-skimmed or whole milk is recommended for its contribution of vitamin D, which favors calcium absorption.*

7.2. NUTRITIONAL GUIDELINES DURING A MATCH

Table 22. Example of dietary-nutritional planning for competition.

Moment	Proposal	Nutritional information (approximately)
1-2 hours before	500 ml water Ham sandwich + yoghurt + banana 1 caffeine capsule or gum	Carbohydrates: 65 g Protein: 18 g Fat: 4 g Liquid: 500 ml Caffeine: 150-200 mg
During (break interval)	500 ml of sports drink or 1 sports gel 500 ml water	Carbohydrates: 30 g Protein: 2 g Fat: 0 g Sodium: 272 mg Liquid: 500 ml
After	1 protein sports bar + 1 sports bar + 500 ml water	Carbohydrates: 50 g Protein: 25 g Fat: 4 g Liquid: 500 ml

FOOD PROPOSALS DURING A MATCH

Table 23. Dates nuts and cocoa bars.

Ingredients	400g of dates 150g of walnuts 30g of pure cocoa powder with no added sugar (3 tablespoons)	
Preparation	Make a paste with the pitted dates (with a mortar or mixer). Add the crushed nuts and cocoa powder. In a mold lined with baking paper, press the mixture well and let it rest in the fridge for a minimum of two hours. Cut into bars of the desired size.	
Nutritional information per serving (approx. 50 g)	Energy (kcal) Carbohydrates (g) Fats (g) Protein (g) Sodium (mg)	147.08 7.26 11.35 0.89 23.48

** These suggestions can be used to meet the dietary-nutritional requirements of 30-60 g of carbohydrates per match. They must be combined with the intake of liquids, food and/or sports supplements. A food or snack during a match must be tested during routine training to ensure the athlete's safety regarding food tolerance.*

Table 24. Homemade sports drink.

Ingredients	400-500 ml of water ½ g baking soda (tip of a teaspoon) ½ g of salt (tip of a teaspoon) 20 g of sugar (2 tablespoons) Juice of one orange*	
Preparation	Thoroughly mix all the ingredients using a blender until the mixture is completely liquid.	
Nutritional information per 500 ml	Energy (kcal) Carbohydrates (g) Fats (g) Protein (g) Sodium (mg)	181 40 0.36 1.57 197

** If you wish to change the sports drink flavor, you can use another type of juice (approximately 100ml). These suggestions can be used to meet the dietary-nutritional requirements of 30-60 g of carbohydrates per match. They must be combined with the intake of liquids, food and/or sports supplements. A food or snack during a match must be tested during routine training to ensure the athlete's safety regarding food tolerance.*

Table 25. Energy balls.

Ingredients	140g toasted hazelnuts (1 cup) 300 g dates (1 cup and a half) 20 g of pure cocoa powder with no added sugar (2 tablespoons) 20 g olive oil (2 tablespoons)	
Preparation	Put the hazelnuts in a blender until finely chopped, then add the pitted dates, cocoa and olive oil. Beat again until the mixture is homogeneous. Shape the balls using your hands. They can be kept in the fridge for about two weeks or frozen.	
Nutritional information per unit (approx. 20 g)	Energy (kcal) Carbohydrates (g) Fats (g) Protein (g) Sodium (mg)	70.5 6.7 4.3 0.65 23.18

** These suggestions can be used to meet the dietary-nutritional requirements of 30-60 g of carbohydrates per match. They must be combined with the intake of liquids, food and/or sports supplements. A food or snack during a match must be tested during routine training to ensure the athlete's safety regarding food tolerance.*

Table 26. Banana energy gel.

Ingredients	1 tablespoon of fructose (10g) 2 tablespoons of glucose (20g) 2 small bananas (approximately 200 g) Raisins (15g) 1 liter of water 1 level tablespoon of honey (10g)	
Preparation	Pour 1 liter of water into a pot. Add a tablespoon of fructose, the fruit cut into small pieces, and the finely chopped raisins. Stir over low heat until a thick syrup is obtained, then add two tablespoons of glucose syrup and the honey. Store the gel in 125ml bottles or in self-closing bags.	
Nutritional information per bottle or bag (approx. 125 g)	Energy (kcal) Carbohydrates (g) Fats (g) Protein (g) Sodium (mg)	48.34 11.05 0 0.08 0.57

** These suggestions can be used to meet the dietary-nutritional requirements of 30-60 g of carbohydrates per match. They must be combined with the intake of liquids, food and/or sports supplements. A food or snack during a match must be tested during routine training to ensure the athlete's safety regarding food tolerance.*

Table 27. Energy bars.

Ingredients	150g oat flakes 175g peanut butter 50 g honey (5 tablespoons) 50g pumpkin seeds Cinnamon to taste	
Preparation	Combine all ingredients, knead well and refrigerate until well compacted. You can also add different toppings such as nuts or cocoa to change the flavour and vary.	
Considerations	The recipe produces several bars that can be cut into different sizes depending on the type of training (longer or shorter) that will be followed.	
Nutritional information per serving (approx. 50 g)	Energy (kcal) Carbohydrates (g) Fats (g) Protein (g) Sodium (mg)	1825.5 141.75 101.15 72.34 23.48

** These suggestions can be used to meet the dietary-nutritional requirements of 30-60 g of carbohydrates per match. They must be combined with the intake of liquids, food and/or sports supplements. A food or snack during a match must be tested during routine training to ensure the athlete's safety regarding food tolerance.*

Table 28. Banana Oatmeal Cookies

Ingredients	1 banana (125g) Oat flakes (50g)	
Preparation	Mix all the ingredients using a fork until a uniform dough is obtained. Cinnamon, fat free cocoa or even dried fruit such as chopped nuts can be added. Shape the dough on baking paper and oven cook for 15 minutes at 180ºC. Let cool after removing from oven.	
Nutritional information	Energy (kcal) Carbohydrates (g) Fats (g) Protein (g)	278.5 55.88 3.9 7.34

** These suggestions can be used to meet the dietary-nutritional requirements of 30-60 g of carbohydrates per match. They must be combined with the intake of liquids, food and/or sports supplements. A food or snack during a match must be tested during routine training to ensure the athlete's safety regarding food tolerance.*

7.3. NUTRITIONAL GUIDELINES AFTER A MATCH

The recovery of muscle glycogen and adequate rehydration will be essential for an athlete's comprehensive recovery. For optimal recovery, it is essential to respect the "4 Rs".

- Rehydrate through water or the liquid base of any drink plus electrolytes, especially sodium.
- Recharge lost muscle glycogen with carbohydrates from the same liquid base or foods that provide them, for example, fruit.
- Rebuild muscle that has been "damaged" by exercise, with protein from foods such as yoghurt, cottage cheese, whey protein powder supplements, or plant-based protein.
- Repair the depressed immune system after physical exercise with antioxidant phytonutrients, especially flavonoids and vitamin C; improve inflammation with anthocyanidins, omega-3s, and other nutrients with anti-inflammatory capabilities.

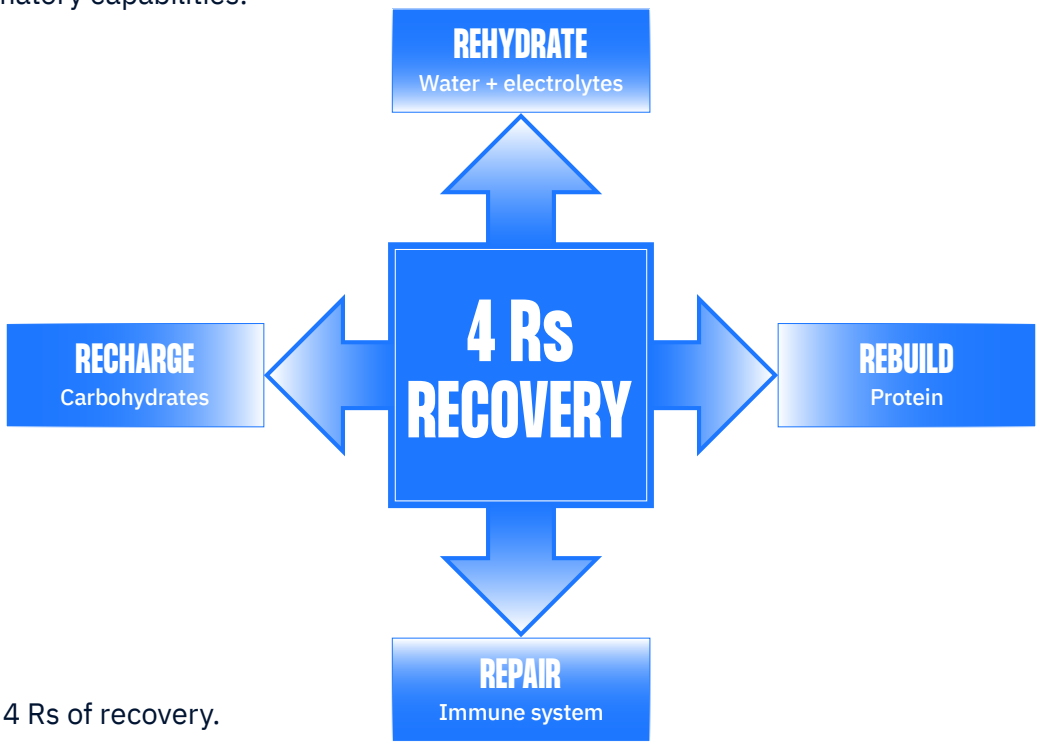


Figure 11. The 4 Rs of recovery.

Between 0.8-1g of carbohydrates/kg of weight. A total of 75% of the caloric intake should come from high glycemic load carbohydrates such as glucose, sucrose, fructose, and maltodextrins (called rapidly absorbed sugars). Between 20g and 30g of protein. At least 500ml of liquid, with a small amount of sodium (800-1150 mg/L). 150% of the weight lost during training or competition must be regained.

Table 29. Post-exercise or recovery Tutti-frutti shake.

Ingredients	1 low-fat yogurt (125g) 1 pear (skinless) (130g) 1 banana (120g) 2 dessertspoons of sugar (10g) Walnuts (5g) 200ml of orange juice Product dose with 80% protein flavor of fruits or yogurt
Nutritional composition	Energy: 481.9 kcal Carbohydrates: 73.7 g Protein: 33.4 g Fats: 5.7 g Sodium: 176.3 mg
Comment	Should be ground in a blender or mixer. Add ice or place in fridge to keep cool.
Special recommendations	The protein supplement can be replaced by powdered milk, milk or yogurt. Females: do not add sugar (10g) or use 1/2 banana and use half a dose of the protein supplement. Males: can add 1/2 banana or 2 dessertspoons of sugar. Children: do not add sugar (10g), use 1/2 banana, and use milk or yogurt instead of the protein supplement.

** Dietetic-nutritional estimates for the following weights: 65 kg for females, 85 kg for males and 55 kg for children.*

Table 30. Post-exercise or recovery chocolate and orange shake.

Ingredients	1 banana (120g) 1 tablespoon of cocoa powder (10g) 300ml of skimmed milk Product dose with 70-80% carbohydrates and 20-30% protein
Nutritional composition	Energy: 450 kcal Carbohydrates: 86.5 g Proteins: 22.3 g Fats: 1.5 g Sodium: 240.2 mg
Comment	Should be ground in a blender or mixer. Add ice or place in fridge to keep cool. The amount of carbohydrates can be reduced by using half a banana.
Special recommendations	The supplement can be replaced by powdered milk, milk or yogurt. Females: do not add the banana. Children: use milk or yogurt instead of the supplement.

** Dietetic-nutritional estimates for the following weights: 65 kg for females, 85 kg for males and 55 kg for children.*

Table 31. Post-exercise or recovery San Francisco shake.

Ingredients	200ml of orange juice 100ml of lemon juice 200ml of pineapple juice Product dose with 70-80% carbohydrates and 20-30% protein Ice (optional)
Nutritional composition	Energy: 374 kcal Carbohydrates: 76 g Protein: 10.8 g Fats: 0.8 g Sodium: 140 mg
Comment	Should be ground in a blender or mixer. Add ice or place in fridge to keep cool. Add a 50% Protein Bar or 2 low-fat yogurts to meet post-exercise protein needs.
Special recommendations	The supplement can be replaced with powdered milk, milk, or yogurt. Females: use 100ml of orange and pineapple juice and add 10g of neutral flavor protein. Males: add 15g of neutral flavor protein. Children: use 100ml of orange and pineapple juice and use milk or yogurt instead of the supplement.

** Dietetic-nutritional estimates for the following weights: 65 kg for females, 85 kg for males and 55 kg for children.*

Table 32. Post-exercise or recovery Piña colada shake.

Ingredients	100ml of milk 300ml of pineapple juice 1 tablespoon grated coconut (10g) 1 tablespoon of sugar (10g) Product dose with 80% coconut or pineapple flavor proteins (30g)
Nutritional composition	Energy: 321.2 kcal Carbohydrates: 49.43 g Protein: 29.4 g Fats: 5.2 g Sodium: 85.2 mg
Comment	Should be ground in a blender or mixer. Add ice or place in fridge to keep cool. To increase the amount of carbohydrates, add 1 or 2 tablespoons of sugar or have a cereal bar.
Special recommendations	The protein supplement can be replaced by powdered milk, milk or yogurt. Females: add a 1 tablespoon of sugar (10g) and use 1/2 dose of protein supplement. Males: add a sports bar. Children: use milk or yogurt instead of the protein supplement.

** Dietetic-nutritional estimates for the following weights: 65 kg for females, 85 kg for males and 55 kg for children.*

Table 33. Post-exercise or recovery Black and white shake.

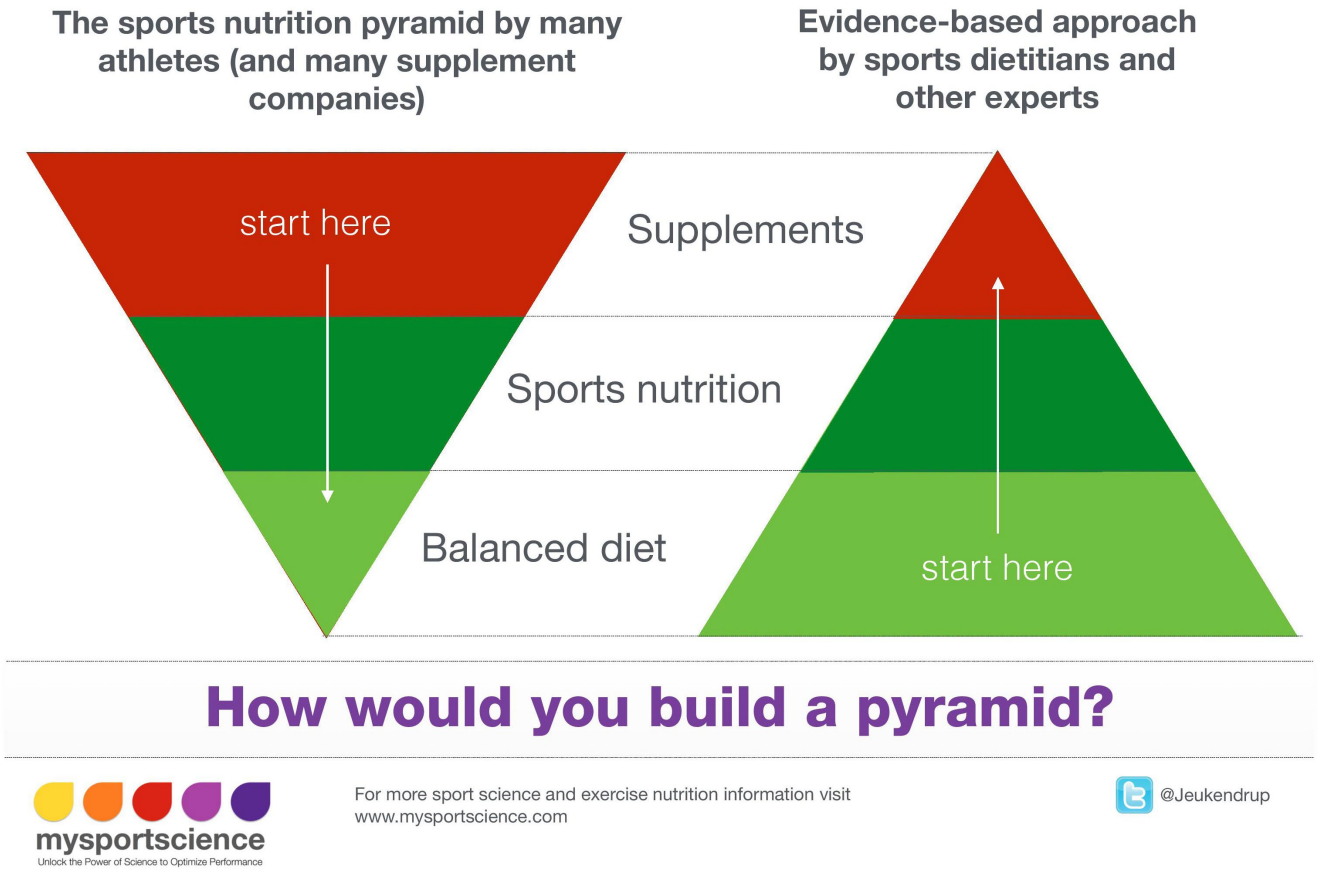
Ingredients	1-2 tablespoons of instant coffee (10-20g) 400ml of skimmed milk 2 tablespoons of sugar (20g) Product dose with 80% chocolate flavor protein
Nutritional composition	Energy: 292.35 kcal Carbohydrates: 40.4 g Protein: 25 g Fats: 1.4 g Sodium: 205 mg
Comment	Should be ground in a blender or mixer. Add ice or place in fridge to keep cool.
Special recommendations	The protein supplement can be replaced by powdered milk, milk, or yogurt. Females: add 3 dessertspoons of sugar (15g) and use half a dose of the protein supplement. Males: add 3 tablespoons of sugar (30g) or a sports bar Children: use milk or yogurt instead of the protein supplement.

** Dietetic-nutritional estimates for the following weights: 65 kg for females, 85 kg for males and 55 kg for children.*

8. SPORTS SUPPLEMENTS FOR ADULTS

Sports supplements can be defined as a food, food component, or nutrient that is purposefully ingested, in addition to the habitually consumed diet, with the aim of achieving a specific physical performance or health benefit (Maughan et al., 2018).

It should first be emphasized that the basis for good performance is proper nutrition, sports supplements should be used to "complete" the diet, not replace it, nor should they be the primary focus.



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It seems that there are no significant differences in the prevalence of use between males and females and between professional and amateur handball players (Muñoz et al., 2020), Handball players mainly consume sports drinks, energy bars, and caffeine to increase their performance. Table 34 and 35 below shows sports supplements with good to strong evidence of achieving benefits to performance when used in specific scenarios, and which may provide benefits to handball players.

Table 34. Summary of common sports foods and functional foods used by athletes. Adapted from Maughan et al., 2018 and Peeling et al., 2019.

Sports food	Form	Composition	Use
Sports drink	Powder or ready to drink liquid	• 5%–8% CH • 10–35 mmol/L sodium • 3–5 mmol/L potassium	• Simultaneous delivery of fluid + CH during exercise • post exercise rehydration and refueling
Energy drink	Ready-to-drink liquid or concentrated shot	• Carbohydrate, especially in typical ready-to-drink varieties • Caffeine • Note: may contain taurine, B vitamins and other ingredients with variable supporting evidence and some level of concern	• Pre-exercise caffeine supplement • Carbohydrate and caffeine intake during exercise
Sports gel or sports confectionery	Gel: 30–40 g sachets confectionery: jelly-type confectionery (generally in pouch of 40–50 g)	• ~25 g CH per sachet or ~5 g CH per confectionery piece • Some contain caffeine or electrolytes	• Carbohydrate intake during exercise
Electrolyte replacement supplements	Powder sachets or tablets	• 50–60 mmol/L sodium • 10–20 mmol/L potassium • Typically, low carbohydrate (2–4 g/100 mL)	• Rapid rehydration following dehydration undertaken for weight-making • Replacement of large sodium losses during ultra-endurance activities • Rapid post exercise rehydration following moderate to large fluid and sodium deficits
Protein supplement	Powder (mix with water or milk) or ready-to-drink liquid Protein-rich bar, usually low in CH	• Provides 20–50 g protein in a single serve from high-quality types of animals (whey, casein, milk, egg) or vegetable (e.g., soy) origin • Note: may contain other ingredients, some of which are not evidence-based and may increase the risk of contamination	• post exercise recovery following key training sessions or events where adaptation requiring protein synthesis is desired • Achievement of increase in lean mass during growth or response to resistance training • Portable nutrition for busy schedule or travel

Liquid meal supplement	Powder (mix with water or milk) or ready-to-drink liquid	• 1–1.5 kcal/mL: 15%–20% protein and 50%–70% CH • Low to moderate fat • Vitamins/minerals: 500–1000 mL supplies RDI	• Supplement high-energy diet (especially during heavy training/competition or weight gain) • Low-bulk meal replacement (especially pre-event meal) post exercise recovery (CH and protein) • Portable nutrition for busy schedule or travel
Sports bar	Bar	• 40–50 g CH • 5–10 g protein • Usually low in fat and fiber • Vitamins/minerals: 50%–100% of RDIs • Note: may contain other ingredients, some of which are not evidence-based and may increase the risk of contamination	• CH source during exercise • Post exercise recovery—provides CH, protein, and micronutrients • Portable nutrition for busy schedule or travel
Protein-enhanced food	Milk, yoghurt, ice cream, cereal bars, and other food forms	• Increased protein content from normal food variety achieved by adding protein sources or filtration of water from product • Typically allows normal portion to provide ~20 g protein to meet sports nutrition target	• Value-added food able to achieve protein target for post exercise use or to improve protein content of other meals and snacks in an athlete's diet

RDI= Recommended daily intake; g= grams; mL= milliliters; CH= carbohydrates; l= liters; mmol= one-thousandth of a mole

Table 35. Supplements with good to strong evidence of achieving benefits to performance when used in specific scenarios. Characteristics of each supplement and protocol of use. Adapted from Maughan et al., 2018 and Peeling et al., 2019.

Supplement	Overview	Protocol of use
Creatine	Creatine loading can acutely enhance the performance of sports involving repeated high-intensity exercise (e.g., team sports), as well as the chronic outcomes of training programmers based on these characteristics (e.g., resistance or interval training), leading to greater gains in lean mass and muscular strength and power.	• Dosage from 0.03 to 0.1g per kg of body weight per day (Hickner, Dyck, Sklar, Hatley, & Byrd, 2010).
Beta - Alanine	Beta-alanine augments intracellular buffering capacity, having potential beneficial effects on sustained high-intensity exercise performance.	• Daily consumption of ~65 mg/kg BM, ingested via a split-dose regimen (e.g., 0.8–1.6 g every 3–4 hours) over an extended supplement time frame of 10–12 weeks
Nitrate	Dietary nitrate (NO_3^-) is a popular supplement that has been commonly investigated to assess any benefits for prolonged submaximal exercise and high-intensity, intermittent, short-duration efforts.	• Acute performance benefits are generally seen within 2–3 hours following an NO_3^- bolus of 5–9 mmol (310–560 mg).
Caffeine	Caffeine is a stimulant that possesses well-established benefits for athletic performance across endurance-based situations, and short-term, supramaximal and/or repeated sprint tasks.	• 3–6 mg/kg of body mass (BM), in the form of anhydrous caffeine (e.g., pill or powder form), consumed ~60 min prior to exercise • Lower caffeine doses (<3 mg/kg BM, ~200 mg), provided both before and during exercise; consumed with a CH source

Min= minutes; g= grams; mg= milligrams; kg= kilograms; mmol = millimoles

Table 36 shows when it is recommended to take the different sports supplements indicated in Tables 34 and 35. It is recommended that all sports supplements should be tested during different training sessions as part of nutritional training. The purpose of nutritional training is to reduce the nutrition-related adverse outcomes (for example, gastrointestinal problems) (Jeukendrup, 2017).

Table 36. Supplemental distribution

Sport supplement	Training or competition		
	Before	During	After
Sports drink	X	X	X
Energy drink	X	X	
Sports gel	X	X	
Sports confectionery	X	X	X
Sports bar	X	X	X
Electrolyte replacement supplements	X	X	X
Protein supplement	X		X
Liquid meal supplement	X		X
Creatine	X		
Beta - Alanine	X		
Nitrate	X		
Caffeine	X		

“In any case, and as a general and important rule, you should be careful with some supplements because they can lead to positive doping tests. That is why it is recommended to review the information on the group D supplements of the Australian Institute of Sport *(https://www.ais.gov.au/nutrition/supplements)*, as well as the website that provides in this regard the World Anti-Doping Agency (WADA) and the list of prohibited substances *(https://www.wada-ama.org/en/prohibited-list)*. In addition, as a suggestion, players could check that the supplements to be taken, are on the Cologne list *(https://www.koelnerliste.com)*, to prevent involuntary doping offenses caused by food supplements and sports nutrition.”

9. FOOD INTOLERANCES

9.1. Lactose

- Food intolerance is an adverse food reaction for which no immune system reaction of hypersensitivity can be demonstrated.
- An example is lactose intolerance (commonly known as milk sugar), which is caused by a deficiency of the lactase enzyme.
- Our body cannot digest lactose, so this nutrient passes to the large intestine and is fermented by the gut microbiota bacteria.
- The most common symptoms are usually abdominal pain, flatulence, and diarrhea. These symptoms vary depending on the lactase activity, so some people tolerate small amounts of foods with lactose.

Lactose can be present in food additives, so it is important to pay attention to food labels.

Table 37. Lactose content in different foods

Foods allowed in moderation. Low lactose content (0-2 g/portion or 3-5 g/portion)	**Foods not recommended. High lactose content (5-9 g/portion)**
Lactose-treated milk (lactose-free milk)	Whole milk, semi-skimmed or skimmed
Sorbet	Chocolate
Cured or processed cheese	Powdered or evaporated milk
Butter	Condensed milk
Commercially prepared foods containing solid dairy products or whey	Bechamel sauce
	Creamy or low-fat cottage cheese
	Dry cottage cheese
	Ice creams
	Yoghurt (depending on tolerance)

g= grams

Table 38. Prohibited and permitted substances due to their lactose content.

Allowed	Can contain	Prohibited
Lactic acid (E270)	Toothpastes	Lactaselactose
Riboflavin (E101)	Vitamin complexes	Monohydrate
StarchLactates (E325-327)	Medications (pharmaceuticals)	Milk sugar
Lactic esters (E472b)		Milk solids
Lactylates (E481-482)		Lactitol (E966)
Milk proteins		Traces of milk
Casein or caseinate		Whey
Calcium caseinate		Buttermilk
Sodium caseinate		Whey powder
Lactalbumin		Rennet
Lactoglobulin		Curd
		Milk fats

9.2. Coeliac Disease

- Chronic enteropathy (intestinal malabsorption disease).
- It is caused by gluten, a protein contained in wheat flour, barley, rye, oats and triticale.
- The most frequent symptoms are diarrhoea, weight loss, abdominal distension and lesser food absorption.
- Treatment consists of a strict elimination of gluten from the diet *(wheat, oats, barley, spelt, kamut, rye and derivatives)*.
- More info: **ASSOCIATION OF EUROPEAN COELIAC SOCIETIES**

Gluten can be present in food additives, so it is important to pay attention to food labels.

Table 39. Gluten content in different foods

Gluten-free food	Foods that may contain gluten	Gluten-containing foods
Grains: amaranth, buckwheat, chestnut, corn (maize), millet, polenta (cornmeal), quinoa, rice, sago, sorghum, soya, tapioca and teff. Flour labelled gluten free.	Melted or sliced cheese.	Bread and flour from wheat, barley, rye, and oats
Fresh fruits and vegetables (including potatoes, sweet potato, cassava, or tapioca).	Pate and canned	Breaded and battered
Fresh meat, poultry, fish, eggs, nuts, seeds, pulses, and tofu.	Canned fish in sauce	Pastries and cakes
Milk and derivatives	meatballs and burgers	Pasta (macaroni, noodles, tagliatelle, etc.)
Natural or decaffeinated coffee	Sauces, condiments, food colorants	Milks and malted foods
Infusions	Nuts fried with flour and salt candy and treats	Chocolate generally
Pure cocoa	Christmas sweets	Infusions and drinks prepared with cereals (malt, beer, gin, or grain distillates)
	Powdered instant coffee or tea	

Table 40. How to substitute wheat flour for cooking

Substitutes	Thicken	Equivalent to 1kg of flour
Cornmeal	Rice starch	300g tapioca flour
Rice flour	Potato starch	300g Rice flour
Soybean flour		400g Cornmeal
Potato starch		

g= grams

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