Nutrition and sportive activities in young generations

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OUTLINE

- Nutrition in Young Athletes
- Athlete’s Plate and nutrition in practice
- Nutritional Risk in Adolescent Athletes

Nutrition in Athletes

The athlete, even at high levels, has nutritional needs very similar to those of the healthy individual not engaged at a competitive level, except for an increase in energy and nutrient needs.

There are no particular foods capable of improving athletic preparation and / or performance, but only good or bad eating habits that affect metabolic efficiency and physical and athletic performance.

Athletes must eat larger amounts of their usual foods.

Beneficts for healthy nutrition

A well-chosen diet offers many benefits for athletes:

- achieving and maintaining ideal body weight
- maximum benefit from the training program
- better recovery between training and competitions
- reduced risk of injury and illness

Despite these benefits, many athletes do not meet their nutritional goals.

Common problems include:

- poor knowledge of food and its preparation
- little or outdated knowledge of sports nutrition
- lack of willingness to make good food choices
- use of supplements and sports food

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Sports Dietitians Australia Position Statement: Sports Nutrition for the Adolescent Athlete

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REVIEW ARTICLE

Youth Athlete Development and Nutrition

Ben Desbrow[1]

Hindawi Publishing Corporation
Journal of Sports Medicine
Volume 2015, Article ID 734649, 13 pages
http://dx.doi.org/10.1155/2015/734649

Proper nutrition is a fundamental component of athletes' training and performance plan. The effects of strenuous physiological training and nutritional variations in combination with exercise stress in youth athletes is greatly limited. This limited knowledge is most likely due to the ***ethical considerations of withholding nutrients and physiologically overstressing a vulnerable population such as children and adolescents still in the process of growth and development.***

Review Article

Nutritional Considerations for Performance in Young Athletes

JohnEric W. Smith, Megan E. Holmes, and Matthew J. McAllister

Department of Kinesiology, Mississippi State University, P.O. Box 6186, Mississippi State, MS 39762, USA

NUTRITION REVIEW

Mary Ellen Bingham, MS, RD, CSSD, Mimi E. Borkan, and Paula A. Quatromoni, DSc, RD

Sports Nutrition Advice for Adolescent Athletes: A Time to Focus on Food

Adolescent Nutrition 3

Lancet 2022; 399: 198–210

Strategies and interventions for healthy adolescent growth, nutrition, and development

Dougal Hargreaves*, Emily Mates*, Purnima Menon*, Harold Alderman, Delan Devakumar, Wafai Fawzi, Geva Greenfield, Weeam Hammoudeh, Shanshan He, Anwesha Lahiri, Zheng Liu, Phuong Hong Nguyen, Vani Sethi, Haijun Wang, Lynnette M Neufeld†, George C Patton†

ATHLETE

Nutritional risk

Regular physical activity

High intensity and frequency

Growth

Maturation

Competiotion

Specific body composition

Devevopement

YOUNG ADOLESCENTS

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Growth and Development

Nutrition for healthy growth and maturation is governed by a variety of parameters, each essential in the development from child to adult. Growth, maturation, and development are three constructs paramount in any discussion regarding youth.

Growth simply refers to the quantifiable increase in size, whereas maturation refers to timing and tempo of progress toward the mature state.

Timing and tempo refer to the age at which specific maturational events occur and rate at which an individual progresses through these events. Both timing and tempo vary considerably between children.

Development is considered a social construct that typically focuses on behaviors and attitudes. Conversely, **during late childhood and adolescence, growth accounts for 1-2%, which reflects a slower rate of growth.** With consideration to each of these four components, the FAO/WHO/UNU expert panel used typical weight gains per year to develop age specific and gender specific caloric recommendations.

Table shows the **caloric recommendations** for boys and girls participating in vigorous lifestyles physical activity. Daily energy requirements increase with age and are similar between boys and girls until pubertal ages.

Training 2-3 times a week for a maximum of 2 hours, no energy increase necessary with respect to growth needs

Make parents understand that there is an important association between nutrition and physical activity

Table 1: Age-specific energy requirements for boys and girls who participate in heavy physical activity levels.

Age (years)	Boys (kcals/day)	Girls (kcals/day)
6-7	1,800	1,650
7-8	1,950	1,775
8-9	2,100	1,950
9-10	2,275	2,125
10-11	2,475	2,300
11-12	2,700	2,475
12-13	2,925	2,625
13-14	3,175	2,725
14-15	3,450	2,855
15-16	3,650	2,875
16-17	3,825	2,875
17-18	3,925	2,875

Adapted from FAO/WHO/UNU, 2004 [7].

Energy availability = **Energy intake - Energy expenditure (training)**

The concept expresses the amount of individual energy input that is available for other processes and body functions, once the energy cost of sporting activity has been subtracted

Prolonged periods of low energy availability in adolescent athletes can have a number of health consequences (Bass & Inge, 2010; Meyer et al., 2007; Nattiv et al., 2007):

- **delayed puberty**
- **menstrual irregularities,**
- **poor bone health,**
- **low height,**
- **development of disordered eating behaviors,**
- **increased risk of injury**

The methods of evaluating energy expenditure may be different, but all with important limitations (Heaney et al., 2010)

- **height, weight, BMI, Z-score height, Z-score weight relative to reference standards (e.g., CDC) or skin folds and circumferences**
- **measures of self-reported fatigue, timing and progression through puberty, menstrual dysfunction, and bone mineral density**

Sport Dietitians Australia Position Statement Sports Nutrition for the adolescent Atlete, 2014

- **Carbohydrates are the main source of energy for physical exercise and vital functions e cerebral *(Burke & Deakin, 2010).***
- **Glycogen stores are affected by the lifestyle, training and competition programs undertaken by many athletes *(Burke et al., 2004).***

The recommendations for young athletes suggest at least 50% of young athletes diet should be in the form of carbohydrate or between 3-8 gr of carbohydrate/kg dependent primarily on exercise intensity.

- The recent guidelines have been drawn up on the basis of studies on adult subjects and recommend the evaluation of the following parameters:
  - **Daily workout timing**
  - **Seasonal training calendar**
  - **Competition calendar**

- ***CHO requirement:***
  - simple sugars 30–60 g/h for exercise lasting longer than 60 minutes
  - ✓ **immediate recovery after exercise** 1–1.5g/kg in the 30minutes
  - ✓ **daily recovery:** low intensity activity : 3-5 g/kg/g
  - moderate exercise program (e.g. 1 hour/day workout): 5-7 gr/kg /d
  - endurance program (e.g. training 1-3 hours/day): 6-10 gr/kg /d
  - high intensity exercise program (e.g. training 4-5 hours / day): 8-12 gr/kg /d
  - ✓ **during physical activity**
  - duration from 0-75 min: not requireddurata
    medium/long from 75min a 2,5h: 30-60g / h
    (Burke et al., 2011)

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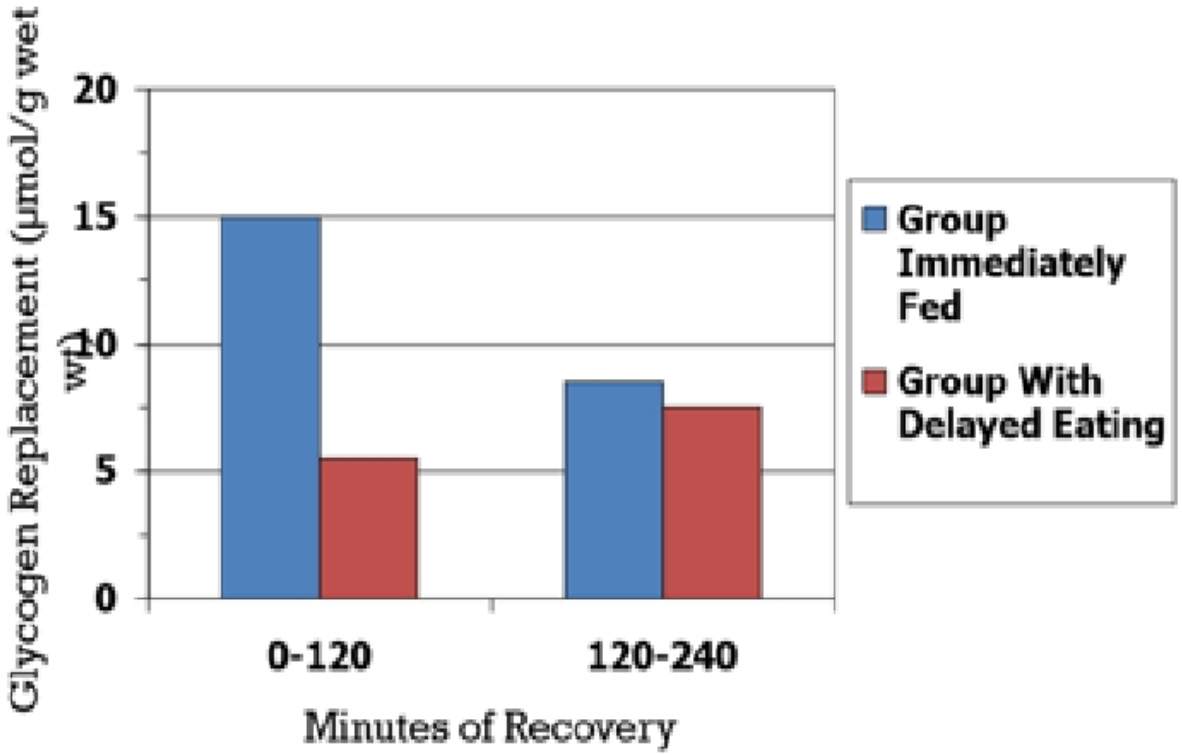
Sports Dietitians Australia Position Statement: Sports Nutrition for the Adolescent Athlete

ADOLESCENTS

Young athletes are better able to utilize fat as a fuel or are potentially limited in their maximal performance as a result of not being able to utilize carbohydrate readily enough at higher intensities.
Research has shown that increasing glycogen stores will enhance exercise performance and reductions in muscle glycogen content correspond with increasing levels of fatigue.
Unfortunately, young athletes have been shown to store less glycogen than adults. During prolonged exercise and exercise at elevated intensities reduced glycogen levels will lead to early onsets of fatigue. Due to their lower glycogen stores, **young athletes will likely experience accelerated rates of fatigue**. This accelerated fatigue is a result of the inability of the body to maintain sufficient blood glucose levels to meet the young athletes elevated glucose needs of the brain as compared to adults.

Recent research continues to demonstrate the ergogenic effects of carbohydrate ingestion on youth sport.
These recommendations suggest athletes should ingest simple sugars at a rate of 30–60 g/h for exercise lasting longer than 60 minutes. Additionally, athletes should ingest 1–1.5g/kg of body mass in the 30minutes following cessation of prolonged exercise.

Muscle Glycogen Synthesis After Exercise



Ivy et al. 1998, Journal of Applied Physiology

Protein

- Protein synthesis is highest during infancy and, as such, during this time relative dietary protein intake is at an elevated demand.
- Important in muscle growth
- Amino acids from protein to repair muscle damage
- High-quality protein at every meal
- 1.2-1.8g/kg (more than 2.0g/kg is not beneficial)
- Adequately distribution during the day
- It’s not only important how many, but when!

In adolescent athletes, protein intake must also support physiological growth and development *(Aerenhouts et al., 2011; Meyer et al., 2007).*

- inadequate energy intake will cause protein to be used as an energy substrate, potentially reducing its availability for its primary functions *(Campbell et al., 2007; Petrie et al., 2004).*

Protein requirement:

1,2-1,8 g/kg/die are recommended in adolescent athletes *(Aerenhouts et al., 2013; Aerenhouts et al., 2011; Gibson et al., 2004; Heaney et al., 2010; Petrie et al., 2004).*

Many studies have shown that adolescents already complete recommended protein requirement by selecting the foods they normally eat *(Aerenhouts et al., 2011; Gibson et al., 2004; Heaney et al., 2010; Petrie et al., 2004)*

Timing of protein intake:

- Distribution within several meals throughout the day
- Post-training: improvement of protein synthesis response (about 20 g of protein) of high biological value during or immediately after strength training *(Hawley et al., 2011; Phillips & Van Loon, 2011)*

	Age	RDI- Protein
Male	12-13 yr 14-18 yr	0,94 g/kg/die 0,99 g/kg/die
Female	12-13 yr 14-18 yr	0,87 g/kg/die 0,77 g/kg/die

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Protein supplementation?

Considering the lack of scientific support for protein based supplements being superior to natural protein containing foods, youth athletes should be advised to consume their protein from whole foods as opposed to supplements.

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TABLE 4.5 TWO MEAL PLANS WITH SIMILAR TOTAL NUTRITIONAL VALUE BUT DIFFERING IN THEIR DISTRIBUTION OF PROTEIN THROUGHOUT THE DAY (FOR AN 80 KG ATHLETE, PROTEIN NEEDS ARE EASILY ACHIEVED WITHOUT THE USE OF EXPENSIVE PROTEIN SUPPLEMENTS)

ADEQUATE PROTEIN—POOR DISTRIBUTION		ADEQUATE PROTEIN—WELL DISTRIBUTED	
MEAL	**PROTEIN**	**MEAL**	**PROTEIN**
Breakfast 2½ cups cereal, low-fat milk 2 slices toast, jam	32	Breakfast 2½ cups cereal, low-fat milk 2 slices toast, jam	32
Morning tea 2 cereal bars	6	Morning tea 200 g low-fat yoghurt	11
Lunch 2 ham, cheese, salad rolls Orange juice	32	Lunch 2 ham, cheese, salad rolls Orange juice	32
Afternoon tea 2 slices fruit loaf	5	Afternoon tea Milk shake	15
Training Water, sports drink	0	Training Water, sports drink	0
Post-training	0	Post-training 300 ml low-fat flavored milk	10
Dinner 250 g lean steak 2 cups steamed rice, vegetables Reduced-fat custard, banana	75	Dinner 120 g lean steak 2 cups steamed rice, vegetables Reduced-fat custard, banana	50
Total protein (g)	150 (1.9 g/kg)	Total protein	150 (1.9 g/kg)

Clinical Sport Nutrition – L. Burke. Mc Graw-Hill Education 2010

Dietary Guidelines should reflect new understandings about adult protein needs

Donald K Layman

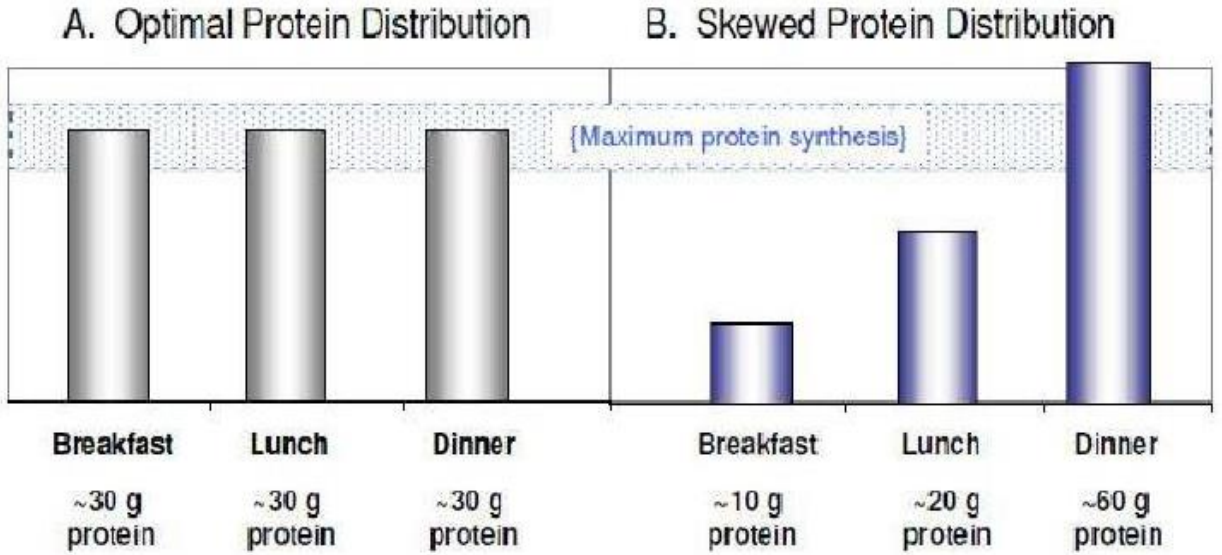

Figure 1

Protein distribution at meals. A) Ingestion of 90 grams of protein, distributed evenly at 3 meals. B) Ingestion of 90 grams of proteins unevenly distributed throughout the day. Stimulating muscle protein synthesis to a maximal extent during the meals shown in Figure 1A is more likely to provide a greater 24 hour protein anabolic response than the unequal protein distribution in Figure 1B. (Adapted from Paddon-Jones & Rassmussen Curr Opin Clin Nutr Metab Care 2009, 12: 86–90.)

- Body can absorb ~ 20-30g of protein at once

Fat

- Most energy dense nutrient: 9 kcal/g
- Transport of vitamin A, D, E, K
- Focus on unsaturated fat – liquid in room temperature
- Oils, nuts, nut butter, seeds, avocado, fish etc.
- Limit saturated fat (solid): butter, margarine, mayo, sour cream, cheese, meat fat, fried food
- Saturated fat promotes inflammation, slows recovery, negatively affects performance

Adequate dietary fat intake is important to ensure adequate intake of fat-soluble vitamins and essential fatty acids, as well as providing adequate energy to support the growth and maturation of a teenage athlete *(Petrie et al., 2004).*

- Fat consumption should comply with the guidelines for non-athletes to reduce cardiovascular risk (20-35% of total energy).
- Young athletes should be encouraged to consume unsaturated fats, fish, and plant-based sources.
- Limit your intake of foods containing high concentrations of saturated fat such as fried foods and baked goods, and use practices that reduce fat content from animal sources (for example, choose lean meats).
- Due to its energy density, the manipulation of dietary fat intake has the ability to influence quickly the total energy intake of a teenage athlete.

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- Calcium and Vitamin D are important nutrients for bone health in adolescent athletes.
- The calcium intake recommendation for adolescent athletes is probably no different from the levels recommended for all adolescents, 1300 mg / day.
- There is evidence that, as with adolescents in general, actual calcium intake by adolescent athletes falls the recommendation which suggests the need for strategies to be implemented to help adolescents, especially girls, achieve adequate calcium intake.
- Many adolescent athletes are at risk for low vitamin D levels and regular monitoring of vitamin D status is recommended. Correction of Vitamin D deficiency or insufficiency may be necessary to ensure optimal performance and bone health in adolescent athletes.

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- The depletion of iron reserves occurs more frequently in female athletes.
- Despite the potential for increased iron turnover in adolescent athletes, there is little evidence that adolescent athletes have needs similar to values recommended for all adolescents.
- Teenage athletes (especially females) should ensure dietary iron intake as recommended levels
- Iron supplementation should only be considered if justified by the point of medical view.

HYDRATION AND TEMPERATURE REGULATION

There are differences between adults and children.

Children/adolescents:

greater acquisition of heat from the external environment and therefore also greater loss at low ambient temperatures

Children produce more metabolic heat per unit of mass than adults during physical activities

The sweating capacity is considerably lower than in adults, which reduces the ability of children to dissipate heat

- Adolescents have been shown to have diminished sweat rates as compared to their adult counterparts. Diminished sweat rates are advantageous as a result of their protection of body water status but are disadvantageous due to the reduced ability to dissipate heat.
- Added importance of hydration is due to the fact that, in addition to performance decrements, hypohydration
- has been shown to lead to increased physiological strain, increased risk of heat injury/illness, and increased perceived exertion at similar workloads.

- Despite the developments in the understanding of thermoregulation in children and adolescents, fluid intake is important in sports nutrition in the developmental age given the increase in the prevalence of heat sickness associated with sport and activity in younger athletes (CDC, 2011).

- Field studies indicate that adolescent athletes can experience significant fluid deficits (≤ 4% of body weight) during heat training and competition (Aragon-Vargas et al., 2013; Silva et al., 2011)

Heat sickness can be affected by:

- **inadequate hydration status**
- **physical exertion**
- **insufficient cooling between training periods**
- **inadequate clothing choices, including uniforms and equipment**

published fluid intake guidelines for adults suggest that athletes should drink during exercise to avoid weight changes> 2% (Sawka et al., 2007); already -1-2% we have limitations on physical activity and decay of the individual's physical abilities

The American College of Sports Medicine's Position Stand on Nutrition and Athletic Performance recommends athletes to consume 5–7 mL/kg of body mass 4 hours prior to exercise, enough fluid to reduce body mass changes to less than 2% during activity, and 450–675mL for every 0.5 kg of body mass lost during exercise

Hydration

- You are made of 55-60% WATER (elite athletes 75%)
- 80% fluids, <20% food
- Critical to sports performance and body functions
- Regulates body temperature (hot climate), regulates pH (lactic acid), blood volume
- Water loss through breathing, digestion, waste elimination, and sweat (in hot climates 90% loss through sweat)

- Sports drinks are regularly consumed by teenagers for a wide range of reasons however, for the active teen engaged in routine physical activity, **the use of sports drinks instead of water on the sports field or as a general drink is not necessary**.

- This is because sodium losses in sweat are generally lower in young athletes than in adults (Meyer et al., 2012)

Sports Dietitians Australia Position Statement: Sports Nutrition for the Adolescent Athlete

- consuming sports drinks can also lead to excessive calorie consumption and an increased risk of overweight and obesity

- For competitive adolescent athletes, the use of carbohydrate/electrolyte sports drinks may offer mediated benefits by providing additional carbohydrates and fluids during periods of prolonged and vigorous sports participation (over 14 years)

- **many adolescents do not understand the differences between sports drinks and caffeinated energy drinks (O'Dea, 2013)**

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Table 1. Factors related to nutrition that could produce fatigue or suboptimal performance in team sports

Factor	Description	Examples of high-risk/common occurrence in team sports
Dehydration	Failure to drink enough fluid to replace sweat losses during a game. May be exacerbated if player begins match in fluid deficit	Matches played in hot conditions, particularly for players with high activity patterns and/or heavy protective garments. Repeated matches (e.g. tournaments) may increase risk of compounding dehydration from one match to the next
Muscle glycogen depletion	Depletion of important muscle fuel due to high utilization in a single match and/or poor recovery of stores from previous activity/match	'Running' players with large total distances covered at high intensities (e.g. midfield players in soccer, Australian rules football). Repeated matches (e.g. tournament) may increase risk of poor refueling from one match to the next
Hypoglycemia and depletion of central nervous system fuels (brain glycogen)	Reduction in blood glucose concentrations due to poor carbohydrate availability	May occur in players with high carbohydrate requirements (see above) who fail to consume carbohydrate during the match

Disturbance of muscle acid-base balance	High rates of H+ production via anaerobic glycolytic power system	Prolonged or repeated intervals of high-intensity activities
Depletion of phosphocreatine stores	Inadequate recovery of phosphocreatine system of power production	Prolonged or repeated intervals of high-intensity activities
Gastrointestinal disturbances	Gastrointestinal disturbances, including vomiting and diarrhea may directly reduce performance as well as interfere with nutritional strategies aimed at managing fluid and fuel status	Poorly chosen intake of food and fluid before and/or during match
Salt depletion (?)	Inadequate replacement of sodium lost in sweat. There is anecdotal evidence that salt depletion may increase the risk of a specific type of whole body muscle cramp	Salty sweaters – individuals with high sweat rates and high sweat sodium concentrations who may acutely or chronically deplete exchangeable sodium pools
Water intoxication/ hyponatremia (low blood sodium)	Excessive intake of fluids can lead to hyponatremia ranging from mild (often asymptomatic) to severe (can be fatal)	Players with low sweat losses (e.g. low activity or game time) who overzealously consume fluid before and during a match

Hydration

- Weigh yourself before and after exercise. The difference in weight will be the liquids lost through sweat
- For 1kg of body weight lost during training drink 1500mL of fluid
- 2kg lost = 3L
- Urine is a marker of hydration (clear)
- Electrolytes: sodium, chloride, potassium
- 1% BW loss, HR increase 5-8 bpm, raise in temp. 0.3˚C
- Training <60min water, >60 min sports drink

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Table 1: Physiological effects of dehydration on the human body

The table below lists some of the commonly observed effects of different levels of dehydration

Percent weight loss	Effects on the body
1 to 2	Increase in core body temperature
3	Significant increase in body temperature with aerobic exercise
5*	• Significant increase in body temperature with a definite decrease in aerobic ability and muscular endurance • Possible 20 to 30% decrease in strength and anaerobic power • Susceptibility to heat exhaustion
6	Muscle spasms, cramping
10 or more	• Excessively high core body temperature • Susceptibility to heat stroke • Heat injury and circulatory collapse with aerobic performance

** With a 5% body weight loss, an athlete will need at least five hours to rehydrate*

Source: Alabama A&M and Auburn Universities, 2003

Athlete's plate

Table 3: Supplemental nutrition recommendations for athletes.

Protein	1.2–1.8 g/kg/day derived from whole food sources *After exercise*: 20 g of high quality protein shortly after exercise
Carbohydrate	*During exercise*: 30–60 g/hr for exercise lasting more than 1 hour *After exercise*: 1.0–1.5 g/kg of body mass within 30 minutes of exercise cessation
Fluid	*Before exercise*: 5–7 mL/kg 4 hrs prior to exercise *During exercise*: assess sweat rate and develop hydration plan to maintain body mass during exercise *After exercise*: 450–675 mL/0.5 kg and additional sodium consideration to account for loss through sweat
Micronutrients	*During exercise*: sodium to offset losses associated with sweat being lost in sweat

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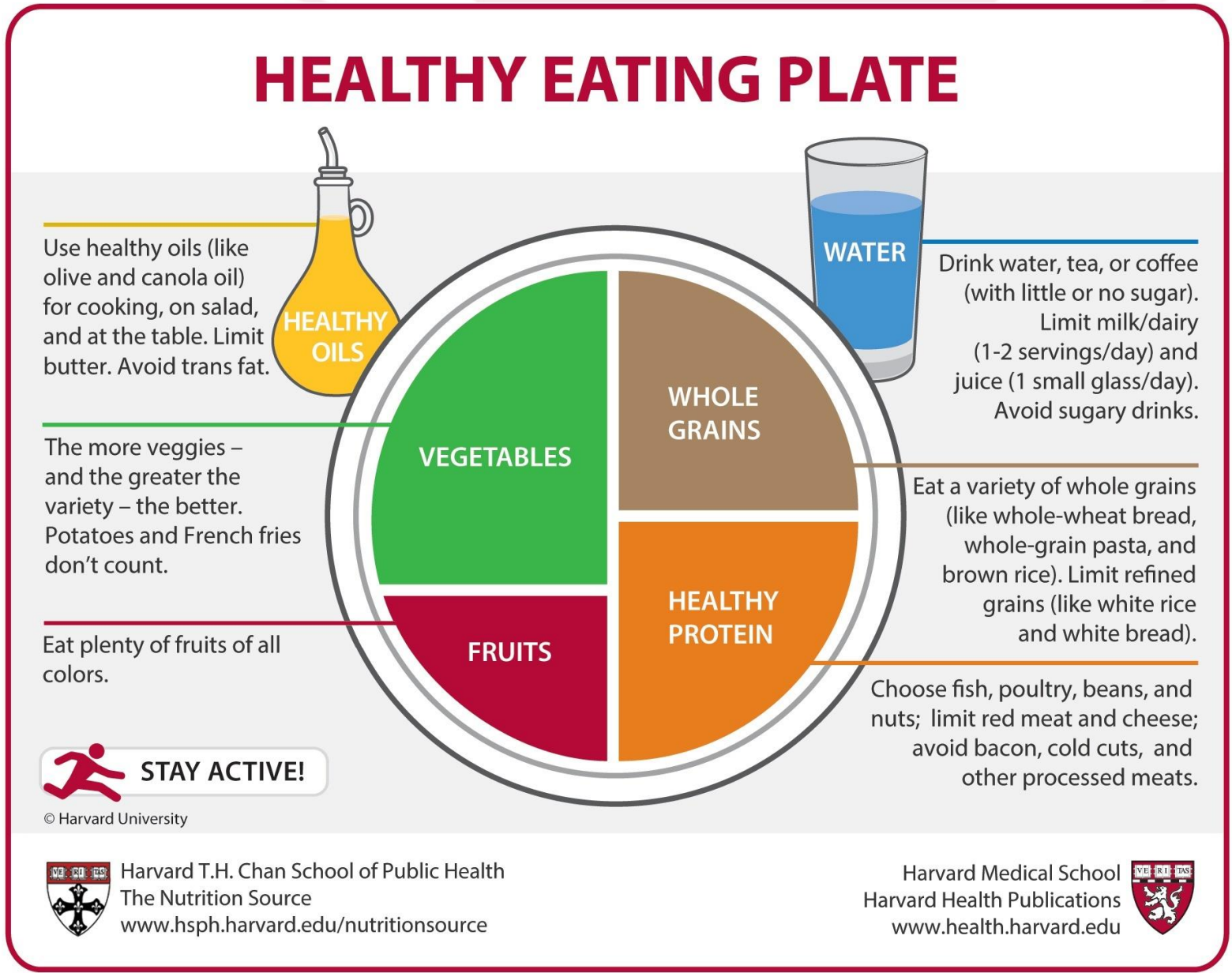
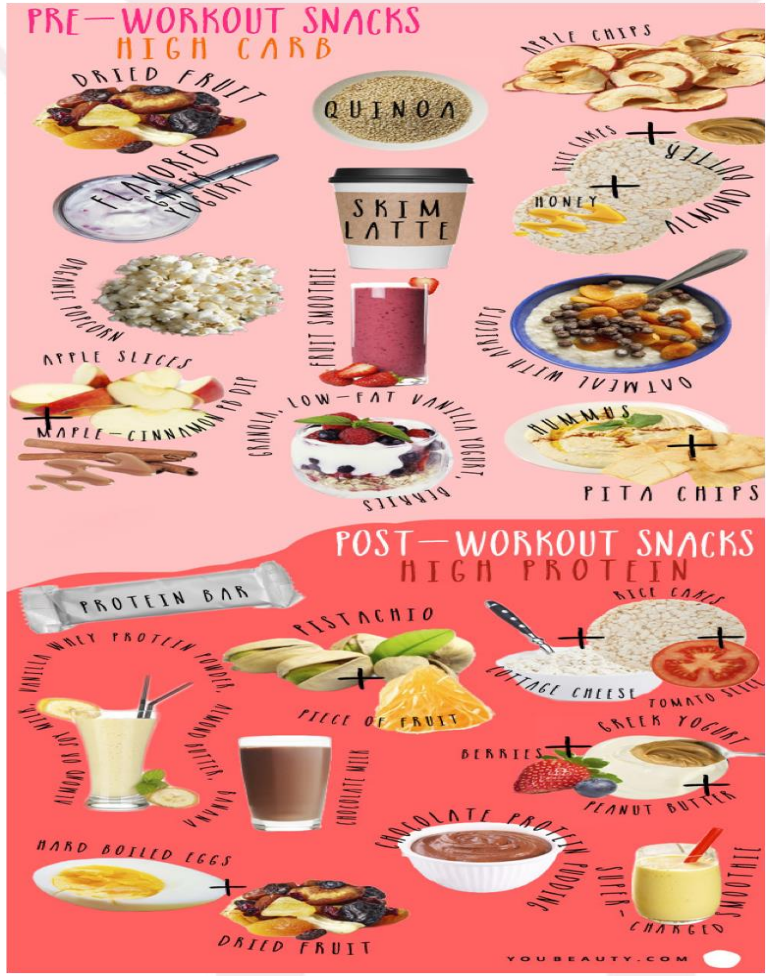


Timing

- Break the fast!
- Every 3-4hrs
- Before training (Low GI carbs)
- Right after training (High GI carbs + protein)
- <2 hrs after training



SNACK BEFOR TRAINING

NO FAT OR FIBER
Prefere Low Glycemic Carbs

Pizza

Fries or junck food

Fruits +
Yogurt

2slices of bread
with ham

Fruit smoothie

Orange
juice with
nuts

NUTRITION REVIEW

Mary Ellen Bingham, MS, RD, CSSD, Mimi E. Borkan, and Paula A. Quatromoni, DSc, RD

Nutritional Risk in Adolescent Athletes

Sports Nutrition Advice for Adolescent Athletes: A Time to Focus on Food

Athletes participating in different sports have **unique nutritional needs** because of differences in energy expenditure, hydration, and the demands of the sport.

Challenges and obstacles to good nutrition are also distinct within subgroups of athletes. **Eating behavior is highly personal**, yet heavily influenced by environment and important others, including peers, teammates, professional athletes, coaches, celebrities, and the media. As such, unhealthy behaviors and nutrition misinformation can set an athlete on a path that could undermine athletic performance, contribute to sports injuries, and have serious health consequences.

These circumstances introduce **vulnerability to nutritional risk** that spans a spectrum and can include **dieting, restrictive eating, disordered eating** (anorexia nervosa, bulimia nervosa, binge eating disorder, anorexia athletica, and orthorexia nervosa), misuse of nutritional supplements, “uninformed” vegetarianism, and a variety of unhealthy weight-cutting practices that can sabotage athletic performance.

Adolescent athletes are quite vulnerable to the ill effects of suboptimal nutrition. The risk for disordered eating and eating disorders is high in the adolescent athlete population.

Not only is their **performance** in sport threatened, but their **growth, development, and maturation can be impaired by poor nutrition.**

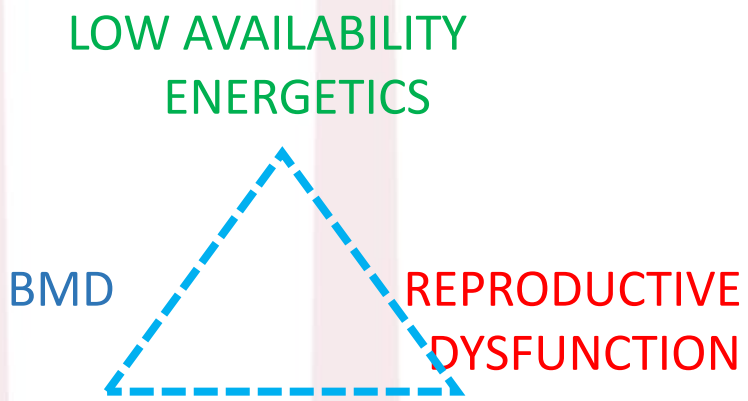
EATING DISORDER AND SPORT

Numerous data indicate that athletes have greater eating problems than non-athletes and the risk increases with high levels of competition.

The sports most at risk are:

- "Endurance" sports (e.g. running, swimming, cycling),
- "Aesthetic" or "physical appearance" sports (eg figure skating, diving, gymnastics)
- "Weight-dependent class" sports (eg wrestling, boxing, martial arts, weight lifting).

ATHLETE TRIAD → **syndrome that occurs especially in competitive athletes who play sports that emphasize thinness. Diagnosed by 3 elements:**



- Too intense physical activity
- RED-S→**ED or nutritional disinformation**

Extension of the syndrome to the male gender → formalmente dalla Female and Male Athlete Triad Coalition nel 2019.

FEMALE TRIAD 1-4% **MALE TRIADE ??**

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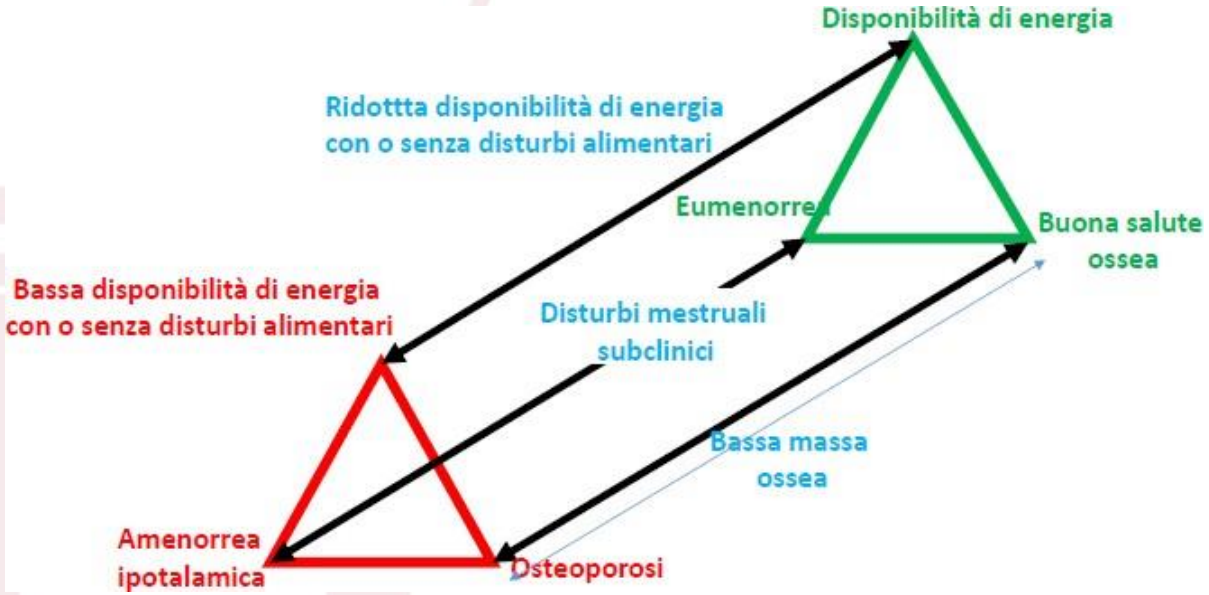
FEMALE ATHLETE TRIAD



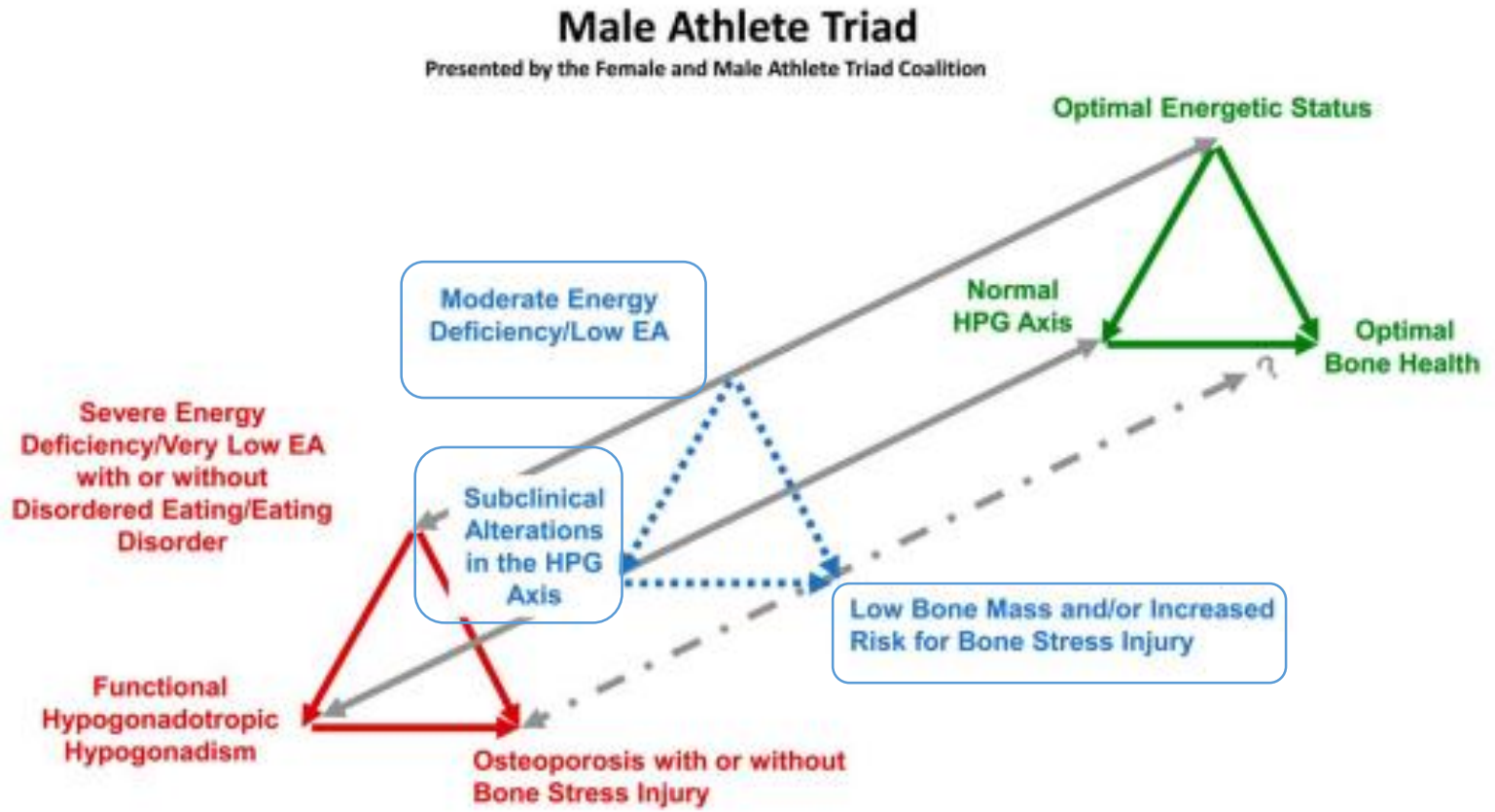
Three major concerns are iron deficiency anemia, compromised bone health, and disordered eating/eating disorders. A well-described combination of risk factors known as the **female athlete triad** consists of **inadequate food intake, amenorrhea, and reduced bone mineral density.** This triad poses a specific threat to athletes in both the short and long term because the opportunity to reach peak bone mass can be negatively affected by poor nutrition during adolescence.

American College of Sport Medicine (ACSM)

The Male Athlete Triad—A Consensus Statement From the Female and Male Athlete Triad Coalition Part 1: Definition and Scientific Basis

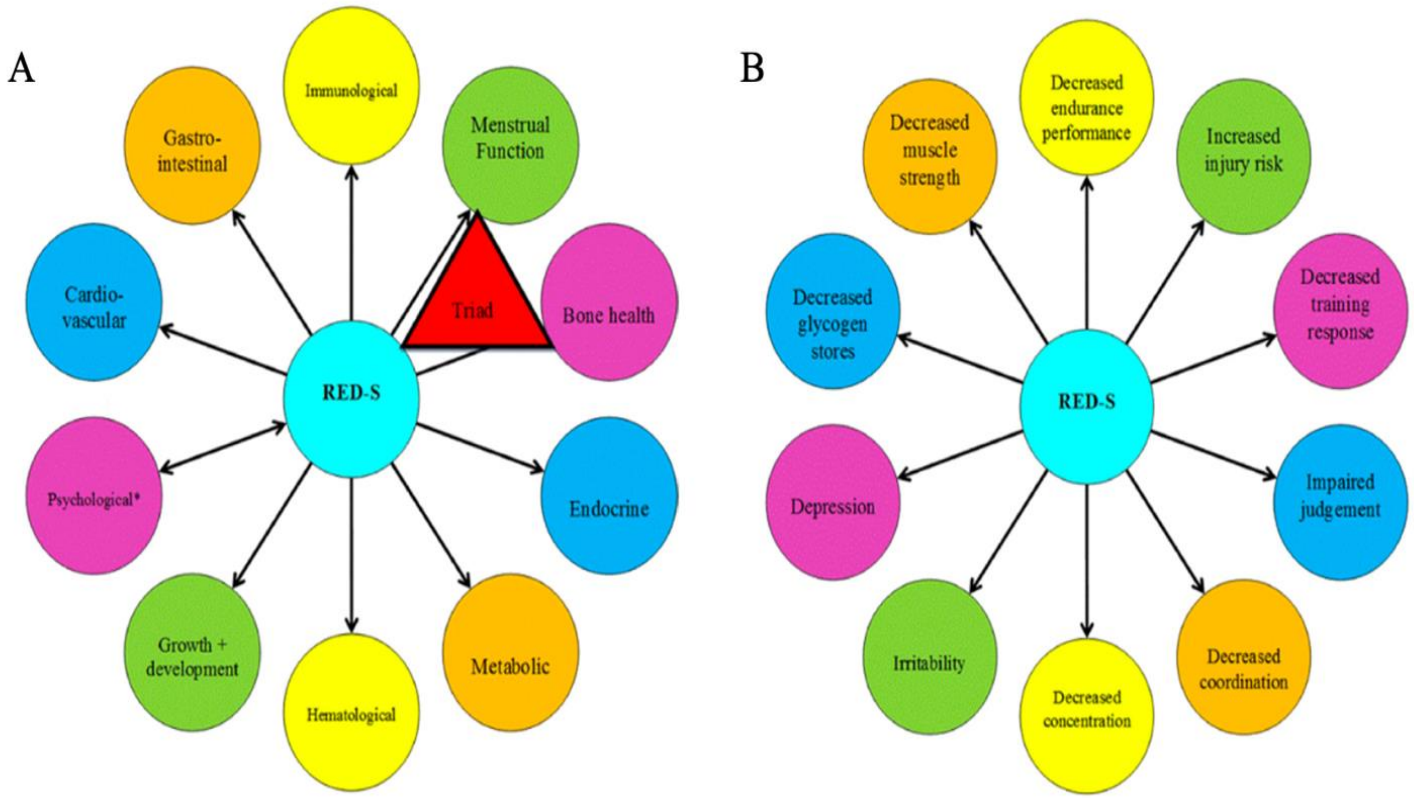
Aurelia Nattiv, MD,* Mary Jane De Souza, PhD,† Kristen J. Koltun, PhD,‡ Madhusmita Misra, MD, MPH,§ Andrea Kussman, MD,¶ Nancy I. Williams, ScD,† Michelle T. Barrack, PhD, RD,|| Emily Kraus, MD,¶ Elizabeth Joy, MD, MPH,** and Michael Fredericson, MD¶

Clinical Journal of Sport Medicine, 2021



Relative Energy Deficiency in Sport (RED-S)

- ACSM, 2007 -



Rappresentazione schematica del modello della Sindrome da carenza energetica relativa nello sport (RED-S) (Mountjoy et al., 2018; Williams N.I. et al. 2019)

In an updated definition acknowledging that male athletes are similarly affected, the triad was described as one piece of a more comprehensive syndrome called **RED-S (Relative Energy Deficiency in Sport).** *RED-S consists of "impaired physiological function including, but not limited to, metabolic rate, menstrual function (in females), bone health, immunity, protein synthesis, and cardiovascular health caused by relative energy deficiency" where an imbalance occurs between dietary energy intake and energy expenditure required to sustain homeostasis, health and activities of daily living, growth, and supporting activities.*

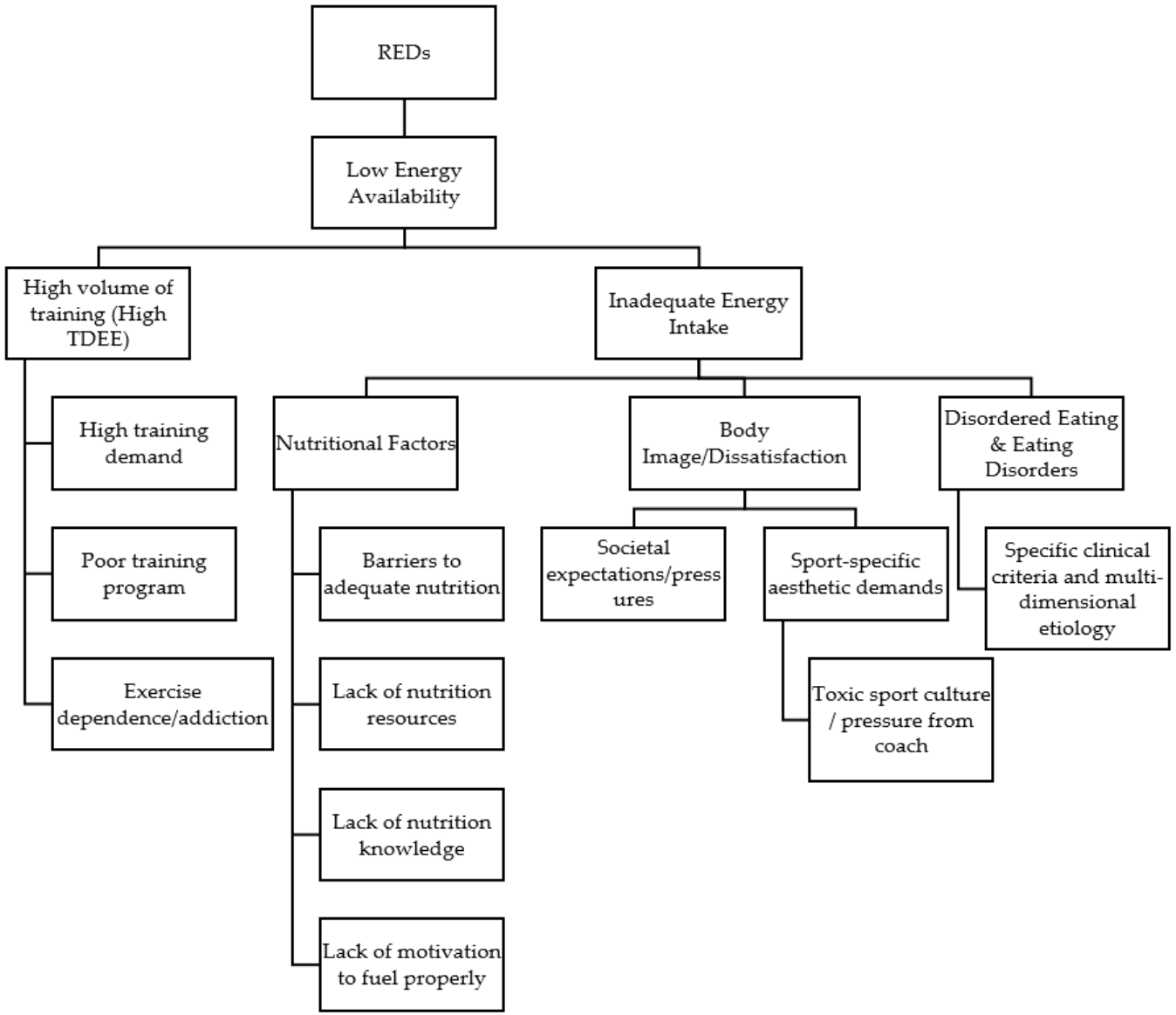
nutrients

MDPI

Review

Contributing Factors to Low Energy Availability in Female Athletes: A Narrative Review of Energy Availability, Training Demands, Nutrition Barriers, Body Image, and Disordered Eating

Andrew R. Jagim [1,2,3,*], Jennifer Fields [3,4], Meghan K. Magee [3,5], Chad M. Kerksick [6] and Margaret T. Jones [3]



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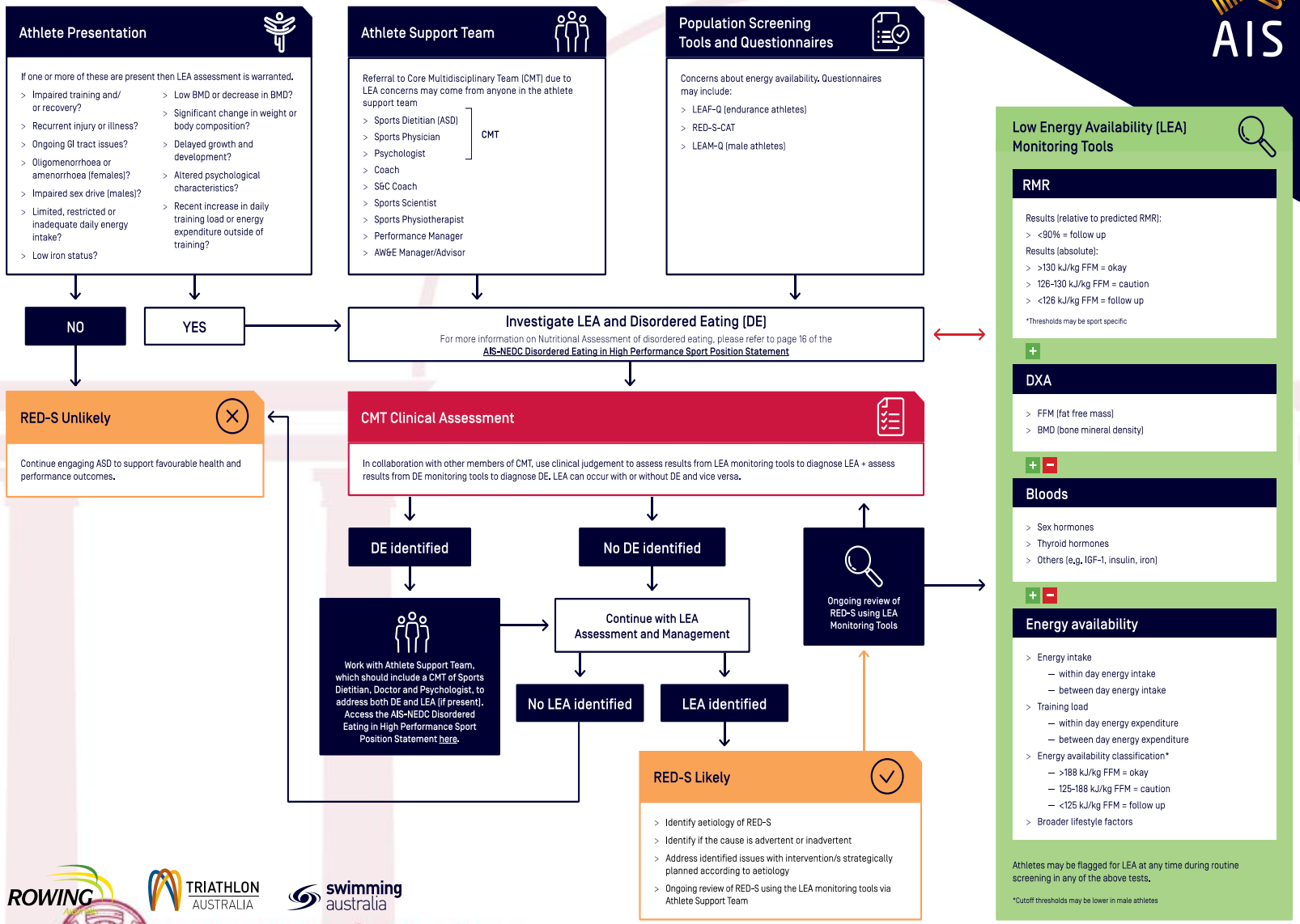
CLINICAL MANAGEMENT OF RED-S



ROWING AUSTRALIA TRIATHLON AUSTRALIA swimming australia

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ASC36037

This infographic was developed by Australian sports dietitians to highlight key areas for the clinical management of RED-S, including:

- the presentation of athlete
- the feedback to athlete
- the assessment of LEAs and monitoring tools
- and the evaluation of eating disorder (ED).

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Thank you for your attention!

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