Nutrition Needs for Active Kids and Young Athletes

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Today's Topics

- Nutrition Goals
- Macronutrients
- Micronutrients
- Fluids
- Eating before and after exercise

Nutrition Goals

1. Proper growth & development
2. Perform optimally in sports
   - Reduce fatigue
   - Recover faster
   - Reduce risk of injury and disease

→ Ensure a fit, strong and healthy young athletes

Growth & Development

1. Skeletal growth
   - Bone length and bone mineral accrual
2. Maturation
   - Skeletal age
     - Development of calcified areas of bone and the external contour changes that result form bone growth and ossification
   - Sexual maturation
     - Secondary sex characteristics, e.g. breast development, age of menarche in girls, genital development in boys, and pubic hair development in both sexes

Skeletal Growth: Bone Length

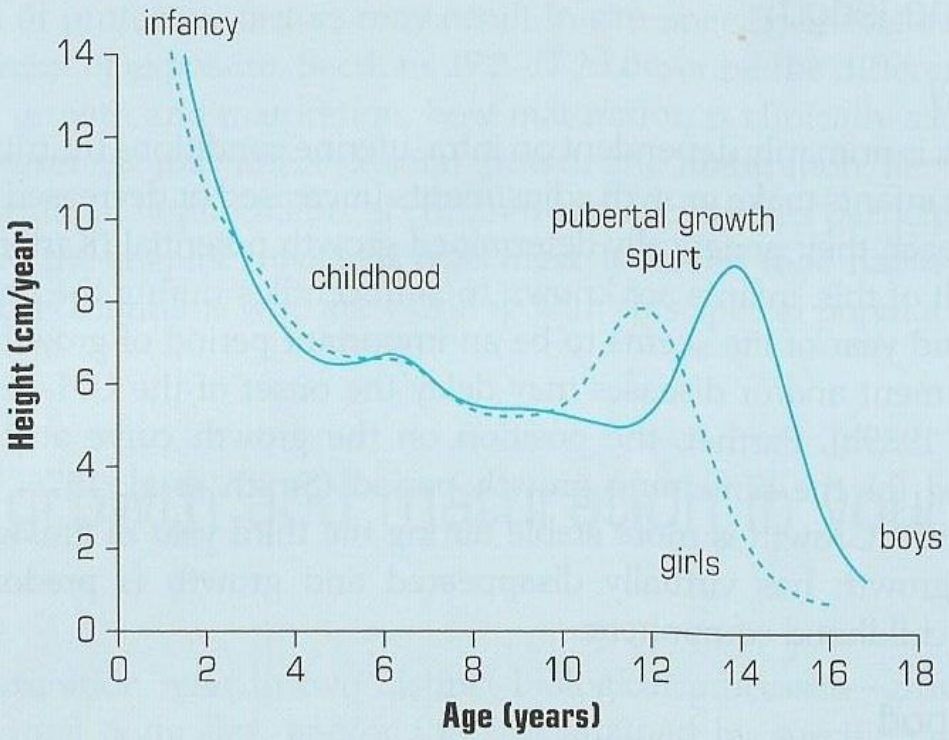


FIGURE 17.1 Skeletal growth velocity. The childhood component, often referred to as prepubertal growth, is nearly identical in girls and boys. During this phase, there is an initial rapid decrease in velocity, and then a slow consistent decline in velocity. The pubertal component is characterized by a growth spurt. Girls generally start their growth spurt and attain their peak height velocity (PHV) approximately 2 years earlier than boys. Adapted from Preece & Ratcliffe 1992

Skeletal Growth: Bone Mineral Accrual

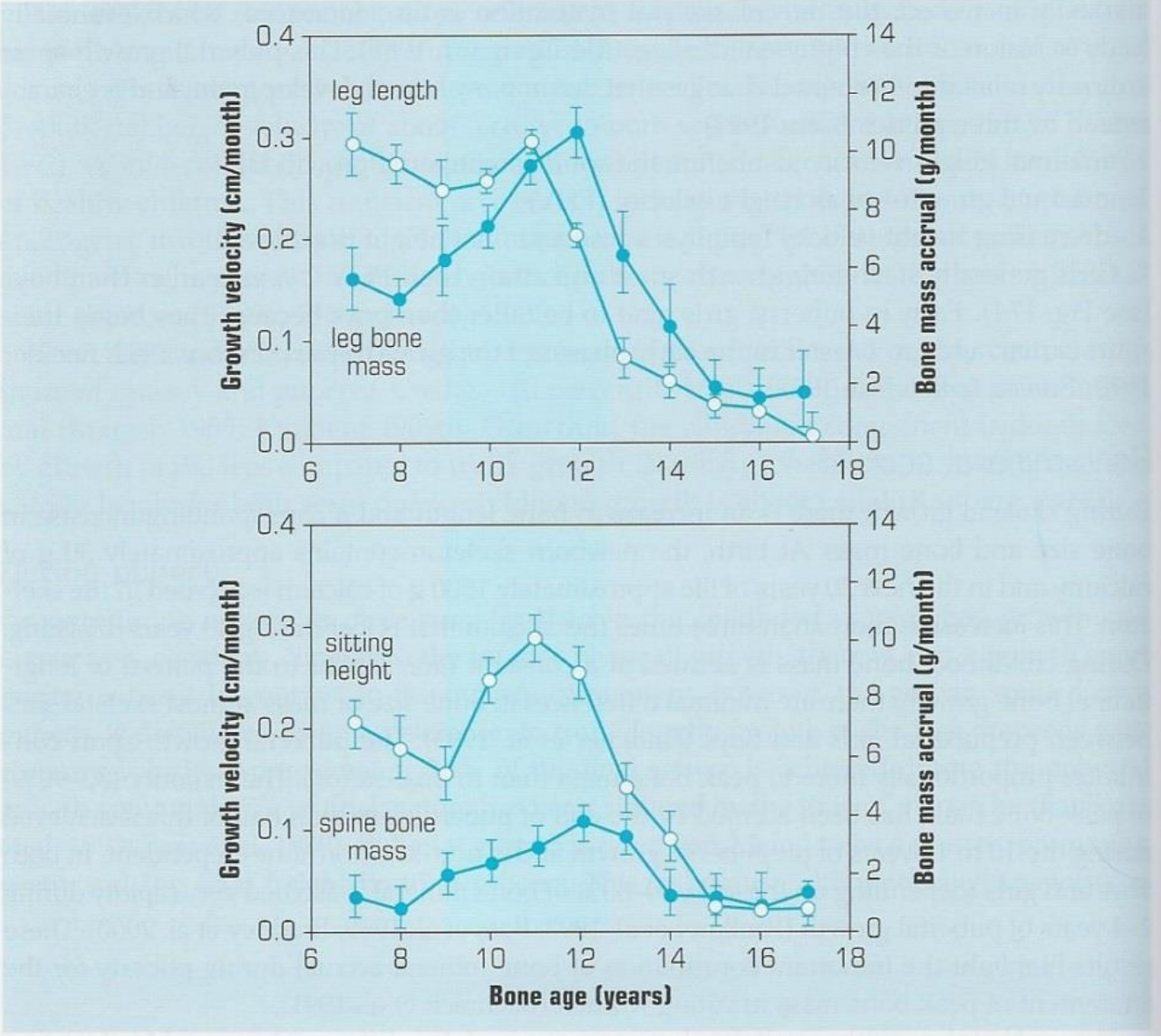


FIGURE 17.2 Growth velocity and mineral accrual during childhood and adolescence. The pubertal growth spurt is characterized by different temporal patterns of growth in bone length (centimeters/month) and bone mass (grams/month accrual). The age of PHV occurs approximately 1 year earlier than the peak rate of bone mineral accrual. The shaded region represents the pubertal years (Tanner stage 2 to menarche). Adapted from Bass et al. 1999

Skeletal Growth

- The majority (80-90%) of peak bone mass has been accrued by the end of puberty
- In both genders, 50-80% of bone mineral is accrued very rapidly during 2-4 years of pubertal growth
- 97% of final stature has been attained by the time of menarche

(Faulkner et al. 1993, Calcif Tissue Int, 53:7-12; Bass et al. 1999, J Clin Invest, 104:795-804; Bradney et al. 2000, J Bone Miner Res, 15:1871-8)

Reduced Growth & Delayed Maturation

- Compromised skeletal growth:
  - A slowing of prepubertal growth to a velocity close to zero, and
  - Reduced or no peak height velocity
- Delayed maturation:
  - Skeletal age being more than 2 years younger than chronological age, and
  - Failure to have the first menstrual cycle by the age of 16 years

Reduced Growth & Delayed Maturation

- The mechanism is unclear, but nutritional insufficiency may be a major contributing factor
- Negative energy balance is know to reduce the levels of insulin-like growth factors I (IGF-I), and the relationship between IGF-I and growth is well known

High Risk Sports

- Slowing of skeletal growth and delayed maturation are often reported in athletes from sports where there is emphasis on leanness (10-20% below desired weight) or in aesthetic sports where there is a focus on a petite build or small body mass (such as gymnastics, long distance running, skiing, figure skating and ballet)

Energy Requirement

- Energy requirement is highly variable, depending on
  - Age
  - Growth rate and stage of physical maturity
  - Activity level, training and competition load
- Energy deficit can cause
  - short stature, delayed puberty, menstrual dysfunction, loss of muscle mass and increased susceptibility for fatigue, injury or illness

Estimated Energy Requirement (kcal/day)

Age, years	Male	Female
4-6	1800	1800
7-10	2000	2000
11-14	2500	2200
15-18	3000	2200

LK Purcell; Canadian Paediatric Society, Paediatric Sports and Exercise Medicine Section. Sport nutrition for young athletes. Paediatr Child Health 2013;18(2):200-202

Estimated Energy Requirement

Estimated Energy Requirement
= Resting Energy Expenditure x Activity Factor

- Limitations:
  - The equation is based on the weight and height within the 10–17 year age category and does not allow for further differentiation by pubertal maturation
  - The broad and subjective nature of the activity factors means that the predictive equations should only be used as a guide
- Indeed, adolescent athletes often report energy intakes lower than those suggested via predictive equations

(Aerenhouts, D., et al. (2011). *Journal of Sports Sciences*, *29*(1), 73–82.; Gibson, J., et al. (2011). *International Journal of Sport Nutrition and Exercise Metabolism*, *21*, 507–514.)

Energy Availability

Energy Availability

= Energy Intake – Exercise Energy Expenditure

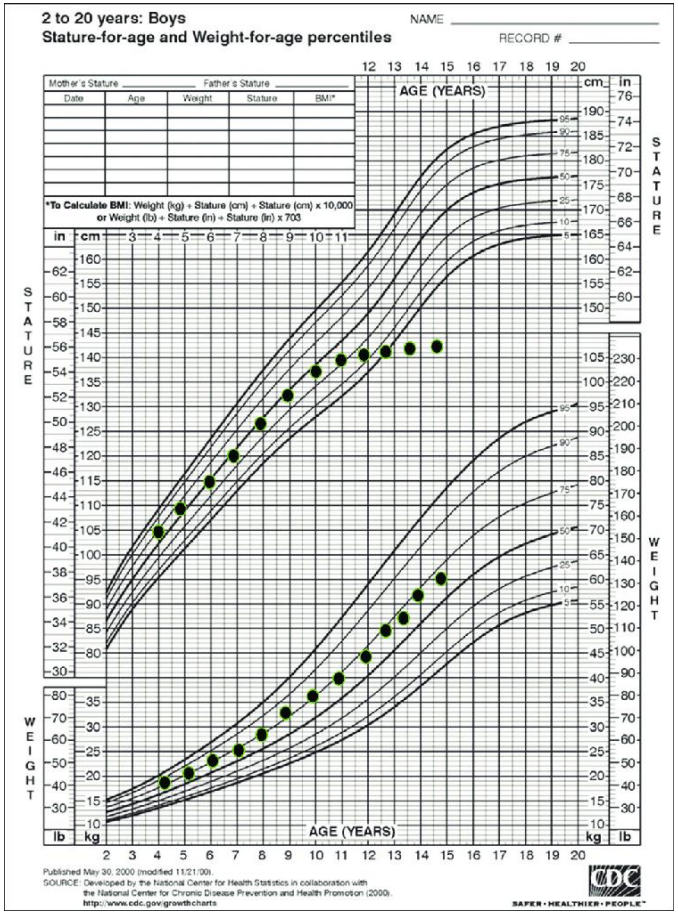
- Energy intake can be assessed using a variety of methods, e.g. 24 food recall, food diary, etc
- Exercise energy expenditure can also be determined using a variety of methods, e.g. heart rate monitors, motion sensors, self-report questionnaires, etc

Energy Availability

- The resultant value of energy availability is then matched against serial measures of growth, development and physiological function to determine if this intake is meeting the needs of the adolescent
- E.g. height, weight, height velocity, weight velocity relative to reference standards
- Other indicators: self-reported fatigue, timing and progression through puberty, menstrual dysfunction and bone mineral density

Energy

- No simple methods exists that can accurately determine the exact energy needs of adolescent athletes
- Therefore, markers of growth and health will help to determine if total energy intake is appropriate



Macronutrients

carbs

proteins

fats

Carbohydrates

- Most important fuel source for exercise
- Stored in muscle and liver as glycogen or blood glucose
- Recommended intake: 45% to 65% of total energy intake
- Good sources of carbohydrates: whole grains, starchy vegetables, fruits, milk and yogurt

Carbohydrates

- Although data is limited, some studies found children and adolescents have a higher reliance on fat than carbohydrate oxidation during moderate intensity exercise
- Also, they tend to rely on dietary carbohydrate during exercise compared with men
- Which may contribute to preserving endogenous fuel use

Carbohydrates

- It’s important to provide carbohydrate food between meals and during exercise in young athletes to help inhibit endogenous carbohydrate usage, and potentially promote rapid recovery of liver glycogen reserves
- Adolescents should adjust carbohydrate intakes to match daily energy demands

Carbohydrates

- For immediate recovery after exercise: (0–4hrs): 1–1.2g/kg/h, then resume daily fuel needs
- For daily recovery:
  - low intensity or skill based activity: 3–5 g/kg/d
  - moderate exercise program (e.g., training 1 hr/d): 5–7g/kg/d
  - endurance program (e.g., training 1–3 hr/d): 6–10g/kg/d
  - extreme exercise program (e.g., training 4–5 hr/d): 8–12g/kg/d
- During sport:
  - short duration (0–75 min): not required or very small amount
  - medium/long duration (75min-2.5h): 30–60g/h

Burke, L.M., Cox, G.R., Cummings, N., & Desbrow, B. (2001). Guidelines for daily carbohydrate intake: Do athletes achieve them? Sports Medicine (Auckland, N.Z.), 31(4), 267–299.

Nutrient-dense Carbohydrates

- High fiber, low fat
- Contain minerals and vitamins
- Provide long-lasting energy, suitable for 2 hours before exercise or low intensity exercise
- Reduce hunger feeling

Refined Carbohydrates

- Only contain carbohydrate, lack of minerals and vitamins
- Easy to digest and absorb, provide instant energy, suitable for moderate to high intensity exercise

High Fat Carbohydrates

- Difficult to digest, it may lead to indigestion if consume before exercise
- High fat content, excess intake may lead to excessive weight gain

Protein

- Main function: growth, build and repair muscle, hair, nails and skin
- Studies have been conducted on adolescent athletes including sprinters and soccer players indicated that positive nitrogen balance is achieved with reported daily protein intakes between 1.35 and 1.6 g/kg/d
- Recent longitudinal evidence suggests that a dietary protein intake within this range will lead to a positive nitrogen balance, irrespective of the adolescent's growth rate or increase in fat free mass

(Aerenhouts et al., (2013). *Int J Sport Nutr Exerc Metab, Aug(4)*:409-17.; Boisseau et al., (2007). *European Journal of Applied Physiology*, *100*(1), 27–33)

Protein

- Adolescent athletes often report protein intakes within the range of ~1.2–1.6 g/kg/d
- Unlikely to require special protein supplements to meet elevated protein needs since dietary protein is found in many foods that are consumed within their current food selection
- Recommended intake: 10% to 30% of total energy intake or 1.3-1.8g/kg/d

(Aerenhouts et al., (2011). *Journal of Sports Sciences*, *29*(1), 73–82; Heaney et al., (2010). *International Journal of Sport Nutrition and Exercise Metabolism*, *20*(3), 245–256; Petrie et al., (2004). *Nutrition (Burbank, Los Angeles County, Calif.)*, *20*, 620–631.)

High Risk Group of Poor Protein Intake

- Active children during growth spurt
- Strict vegetarians
- High carbohydrates intake
- Bulky diet

Protein

- Good sources of protein include lean meat, poultry, fish, eggs, dairy products, beans and nuts, including peanuts
- A regular spread of high quality protein sources across the day, including a plan for the period immediately after a training session, where the consumption of protein containing choices appears to convey the greatest benefits for athletes

Protein post exercise

To optimise muscle protein synthesis

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Aim for 20-25g of protein, maybe more for some, depending on training

Leucine content of protein is important (aim for 3g leucine)

Aim for 8-10g of essential amino acids

Have regular meals (every3-4h)

Leucine Content of a Variety of Foods

Food	Typical portion size (g)	Leucine (g)
Bread (white)	75	1.48
Spaghetti (boiled)	50	2.20
Milk (low fat)	195	2.03
Egg (raw)	60	1.63
Chicken	85	1.49
Steak	175	1.60

Maughan RJ, Burke LM. Practical nutritional recommendations for the athletes. *Nestlé Nutrition Institute Workshop*. 2010; 69: 131 – 149.

Fats

- Necessary to absorb fat-soluble vitamins (A, D, E, K), to provide essential fatty acids, protect vital organs, provide insulation and the feeling of satiety
- Compared to adults, both children and adolescents have a preferential capacity to utilize fat as a fuel source during exercise – as evident from high levels of free glycerol, increased fatty acid uptake and lower respiratory exchange ratios observed during physical activity (Meyer et al. 2007, J Sports Sci, 25 (Suppl):73S-82S)
- However, they do not need to consume additional dietary fat to enhance fat oxidation (Bar-Or & Unnithan 1994, 12 (Suppl):39S-42S)

Fats

- Recommended intake: 20% to 35% of total energy intake, with no more than 10% of total energy coming from saturated and trans fats (e.g. fat in meats, dairy, fried foods, chips, candy and baked products such as biscuits)
- Good sources of fat include lean meat and poultry, fish, **nuts, seeds, and olive and canola oils**
- If an athlete is finding it difficult to meet their energy needs, increasing the unsaturated fat content of the diet can help address this issue due to its energy density (e.g. olive oil, nuts, avocado, and salmon)

Micronutrients

- Although there are many vitamins and minerals required for good health, particular attention should be devoted to ensuring that athletes consume proper amounts of iron, calcium, and vitamin D
- As these nutrients are essential during growth spurt

Iron

- Essential part of the oxygen transport proteins: hemoglobin and myoglobin
- Also a component of oxidative enzymes involved in substrate oxidation to energy within mitochondria
- Iron has a strong role in maintaining the energy release needed to support aerobic and endurance capacity

Iron Deficiency or Iron Depletion

- One of the most prevalent deficiencies in athletes
- Causes
  - High requirement: rapid pubertal growth, increased plasma volume, lean muscle
  - Increased losses: menstruation, sweat loss or gastrointestinal bleeding, “heel-strike” hemolysis
  - Poor dietary habit
    - inadequate energy intake, restricted diet, poor arranged vegetarian diet
    - a high reliance on snack and convenience foods and failure to consume regular meals

High Risk Groups for Iron Depletion

- Adolescents during growth spurt
- Female athletes
- Athletes on low-energy diets
- Vegan or vegetarians
- Distance runners

Iron Status of Adolescent Athletes in HKSI (2014)

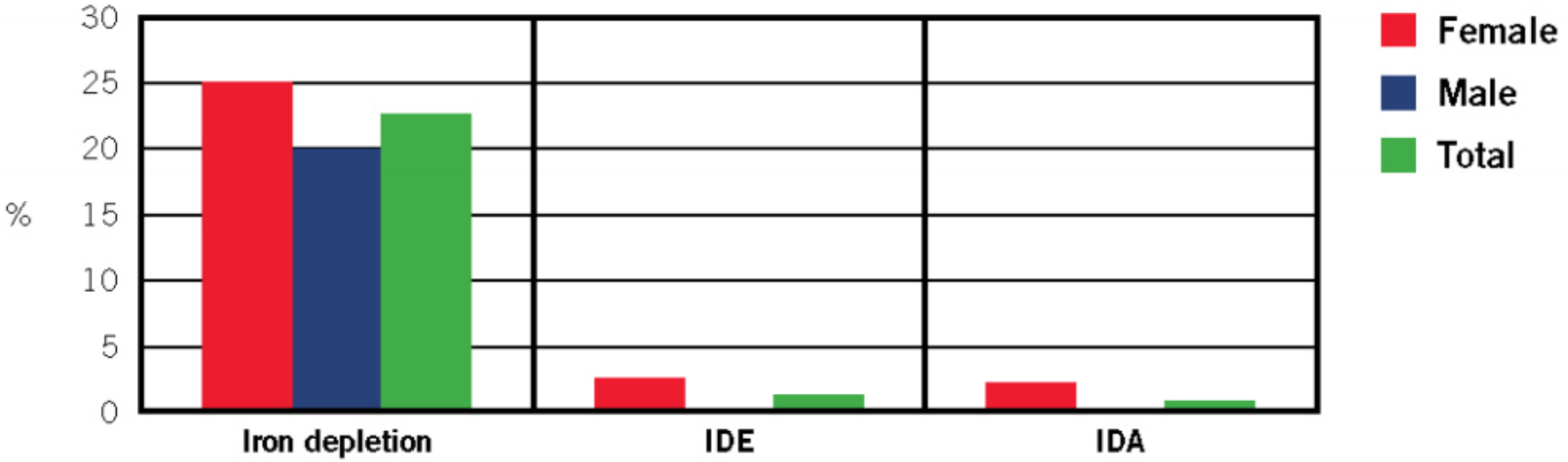


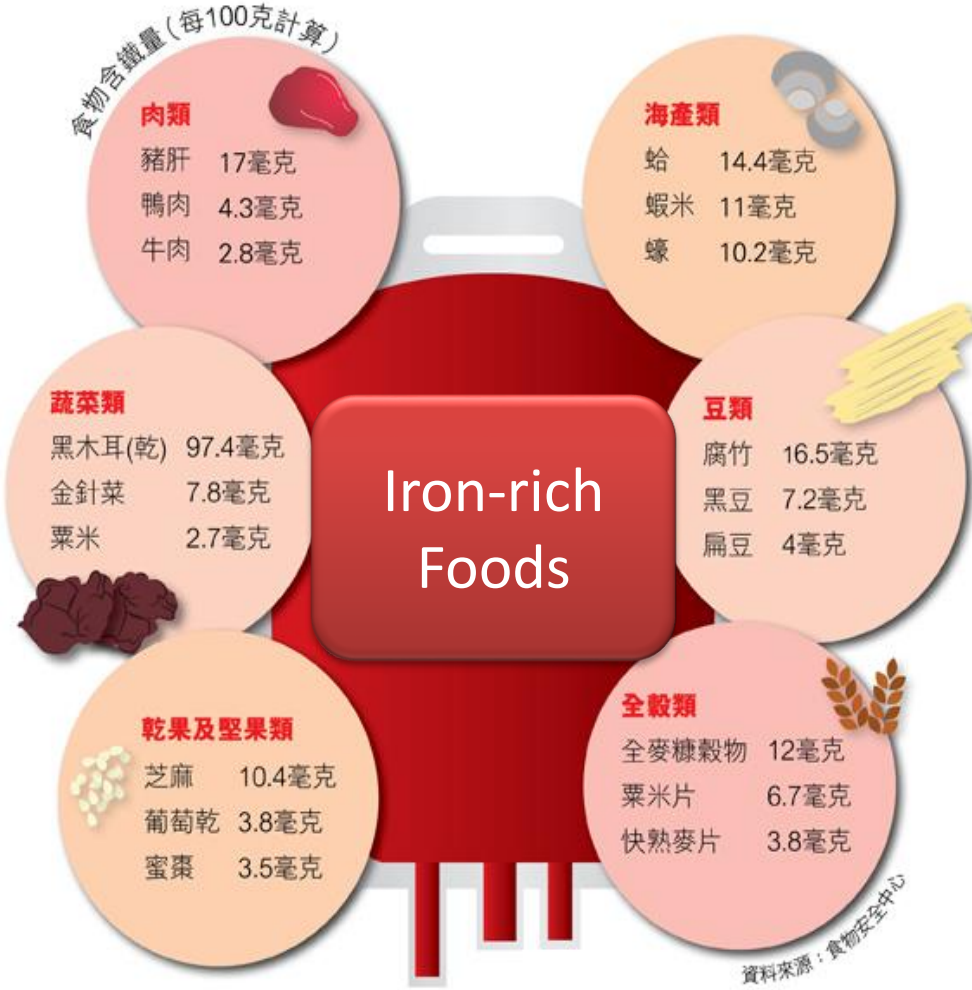
Figure 1. Percentage of adolescent athletes with iron depletion, iron-deficient erythropoiesis (IDE), and iron deficiency anemia (IDA)

Iron-rich Foods

Recommended intake
11 – 13 years old: 15 – 18 mg
14 – 17 years old: 16 – 18 mg
18 – 49 years old: 12 – 20 mg

Foods rich in iron

- Meat: beef, lamb, duck
- Seafood: clams, shrimp, oyster
- Beans: soybean stick, black beans, lentils
- Vegetables: dried lily bud, wood ear fungus, corn
- Seeds and dried fruits: sesame seeds dates, raisins
- Whole grains: fortified cereals



Tips to Enhance Iron Intake and Absorption

- Include meat (beef, lamb, chicken, pork and fish) in every meal
- Include vitamin C-rich foods, e.g. citrus fruit and lightly cooked green vegetable, bell peppers at meal time
- Try iron-fortified breakfast cereals
- Avoid strong tea or coffee, cocoa at meal time

Calcium and Vitamin D

- Calcium is important for bone health, normal enzyme activity and muscle contraction
- Vitamin D is involved in the absorption and regulation of calcium
- Low vitamin D status in adolescent athletes has the potential to impair performance, and increase the risk of injury
- Many adolescents fail to meet the recommended intake, so it is important to try to include calcium-rich foods regularly into the diet and obtain adequate vitamin D

Calcium-rich Foods

Recommended intake
11 – 13 years old: 1200mg
14 – 17 years old: 1000mg
18 – 49 years old: 800mg

250mg – 300mg per serve


Milk


Yogurt


Cheese


Calcium fortified soy milk


Tofu

100mg per serve



Seeds and Nuts

200mg per serve




150g of Dark green leafy vegetables

Vitamin D Status of HKSI Athletes (2014)

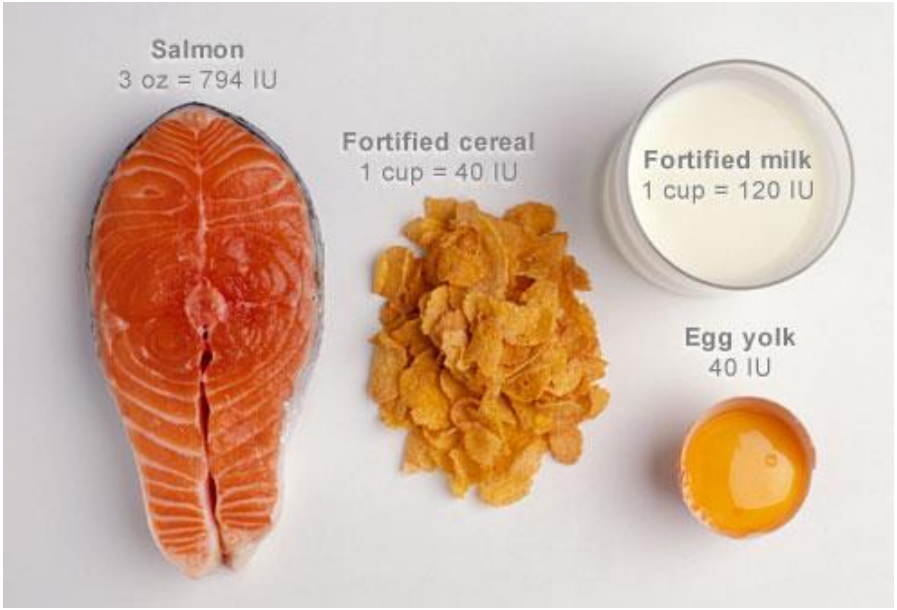
Table 2. Vitamin D status in athletes

Vitamin D status 25(OH)D (ng/mL)	Deficiency <12	Insufficiency 12-19.9	Sufficiency 20-125	Potential adverse effects of high level >125
All athletes (n=185)	6	68	111	0
Adolescent (n=121)	6	50	65	0
Adult (n=64)	0	18	46	0
Indoor sport (n=97)	6	53	38	0
Outdoor sport (n=88)	0	15	73	0
Male (n=94)	1	27	66	0
Female (n=91)	5	41	45	0

Vitamin D Source

Most vitamin D is obtained through exposure to sunlight rather than through dietary sources.

Recommended Nutrient intake
11 – 49 years old: 400IU



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10 – 30 minutes of exposure

Fluids

- Fluids help to regulate body temperature and replace sweat losses during exercise
- Dehydration can decrease performance and put athletes at risk for heat exhaustion or heat stroke
- Factors affect sweat loss: age, gender, body size, temperature, humidity, exercise intensity

Fluids

- There is an increased prevalence of heat-illness associated with sport and activity in younger athletes (CDC, 2011. *MMWR. Morbidity and Mortality Weekly Report*, *60*(29), 977–980.)
- Heat-illness may be influenced by poor hydration status along with other factors such as undue physical exertion, insufficient cooling between exercise bouts and inappropriate choices of clothing, including uniforms and equipment (Council on Sports Medicine and Fitness and Council on School Health, 2011, *Pediatrics*, *128*, e741–e747.)

How much to drink?

- Large variability in sweat rates amongst adolescents
  - Monitor changes in body mass over a session
  - Avoid excessive fluid loss (i.e. >2% of body weight loss)
  - Avoid over-consumption of fluid (i.e. weight-gain)
- Following activity, it requires consuming approximately 1.5 L of fluid/kg of body weight lost

How much to drink?

- Thirst is a late indicator of low hydration status
- A general guideline for young athletes is to drink periodically ‘until you’re not thirsty any more, and then another few gulps’
- For a child younger than 10 years, Bar-Or suggests half a glass beyond thirst
- For an older child or adolescent a full glass beyond thirst

(Bar-Or 1995, J Sports Sci; 13(Suppl):31S-3S)

Peninsula Community Health

NHS

Urine colour chart

Are you drinking enough?

Let your wee help you see!

1 to 3
You are drinking enough!

4 to 5
You're getting dry. Take the time to drink more and hydrate.

6 to 8
You must hydrate! Make every effort to drink more as dark urine is a sign of dehydration.

Its important to note that some medications, vitamin supplements and food can alter the colour of your urine.

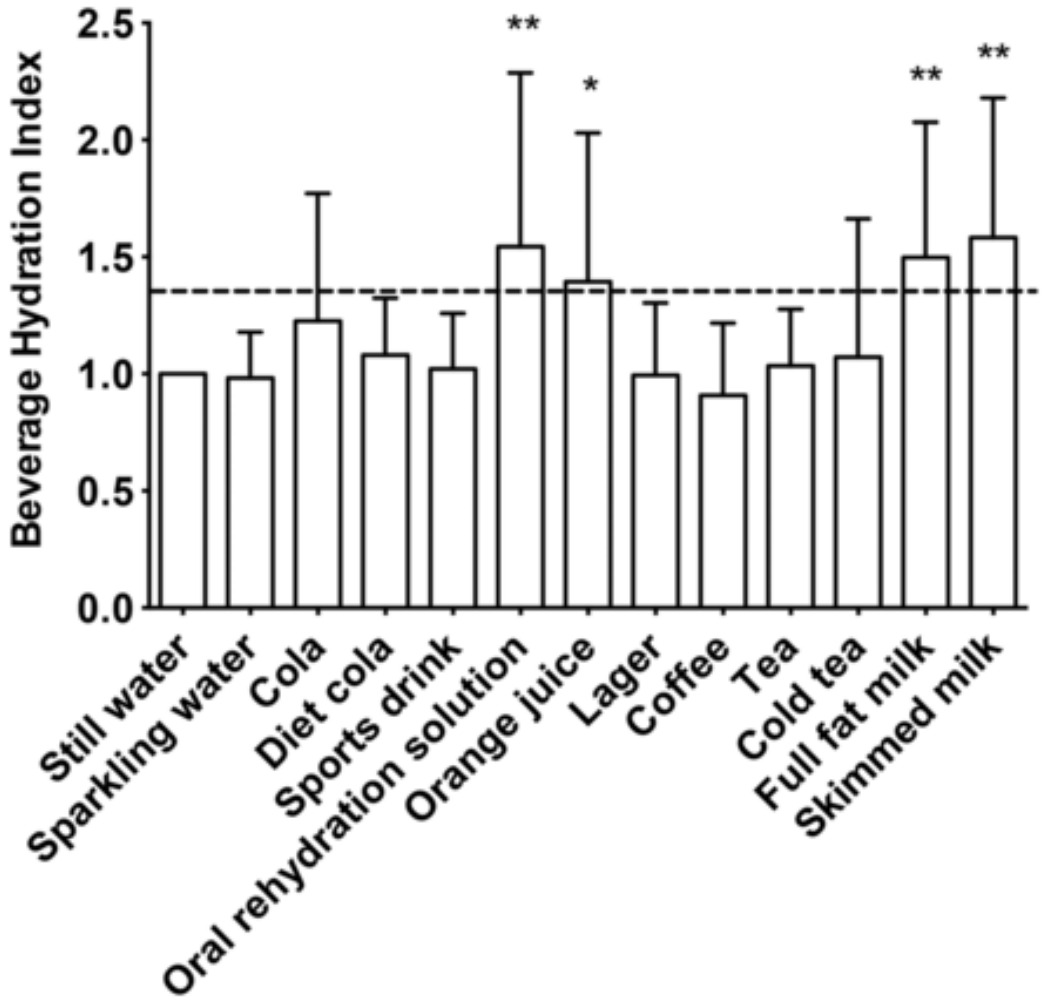
What to drink?

- For events lasting less than 1 hour, water is sufficient
- For training/competition lasting longer than 1 hour, and/or taking place in hot, humid weather, drinks recommended should contain
  - 6% to 8% carbohydrates
  - 20 to 30 mmol/L of sodium chloride

What to drink?

- For non-athletes, routine ingestion of carbohydrate-containing sports drinks can result in consumption of excessive calories, increasing the risks of overweight and obesity, as well as dental caries and, therefore, should be avoided
  (American Academy of Pediatrics, Committee on Nutrition and the Council on Sports Medicine and Fitness. Pediatrics 2011;127(6):1182-9)
- It is important to note that sports drinks are NOT the same as caffeinated energy drinks, and adolescent athletes should NOT be encouraged to consume energy drinks around sporting activities

The potential of different beverages to affect hydration status



Maughan RJ and colleagues, Am J Clin Nutr, March 2016, vol.103 no.3717-723

Sports Drinks & Dental Caries

- Foods known to promote dental erosion are citrus fruits and juices, carbonated and uncarbonated sugary drinks, acidic herbal teas, vinegar and vinegar products, confectionery and acidic medications
- Preventive advices to athletes
  - Drink water after eating between meals to rinse the mouth
  - Consume fluids through a straw or from a squeeze bottle directly into the mouth
  - Chilled fluids
  - Chew sugar-free gum

What to eat before exercise?

- Pre-exercise meal or snack principles:
  - ✓ **Rich in carbohydrate** to prime their fuel stores
  - ✓ **Moderate in protein and fiber,** especially if they have issues with their gut upset or feel very nervous
  - ✓ **Easy to digest** – avoid foods overly high in fat as these are slow to digest
  - ✓ **Familiar** – practice their options in training and don't try anything new on event day!

What to eat before exercise?

- For early morning practices or events, having a snack or liquid meal 1 h to 2 h before exercise, followed by a full breakfast after the event, will help ensure sufficient energy to maximize performance
- Snacks can include fresh fruit, dried fruit, a bowl of cereal with milk, juice or fruit-based smoothies

What to eat after exercise?

- Recovery foods should include carbohydrates, fluids, and protein
- Carbohydrate to protein ratio = 3:1 or 4:1
- Consumed within 30 min of exercise, and again within 1 h to 2 h of exercise, to help reload muscles with glycogen and allow for proper recovery
- Examples include peanut butter sandwich and juice, milk and banana, breakfast cereal with milk, tofu pudding, etc
- Or arrange a main meal after exercise

Nutrition guidelines for quick recovery

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1 

Have carbohydrate 1.2 g/kg of carbohydrate as soon as possible after exercise cessation and every hour thereafter

2 

Avoid excessive dehydration and rehydrate with 150% of weight loss

3 

Experiment with antioxidants, tart cherry juice or protein. Be aware: this is likely less important in relation to performance and may interfere with long term benefits

4 

Add some protein with an eye on long term recovery and adaptation but this is NOT essential for the immediate post exercise recovery

quick recovery refers to 1-6h after exercise

Recovery Drinks

- Low fat chocolate milk, soymilk
- Dairy based smoothie
  - Carbohydrate
  - Protein
  - Fluid
  - Electrolytes

Typical Diet of Adolescents in HK

- Skips breakfast
- Too much meat (high protein) and highly processed foods
- Not enough fruits and vegetables (inadequate vitamins and antioxidant nutrients)
- Too much high fat high sugar snacks
- Eat according to the taste of the food, not according to their needs
- Parents will buy what the kid likes not necessarily what the kid needs

In Conclusion…

- Early education is the key to prevention of problems
- Young athletes may not understand the role of nutrition to them
- If they learn about sound nutrition early, it would help them maximize growth, prevent injury, prevent nutrition related problems in training and competition

In Conclusion…

- Specific recommendations for energy intakes for young athletes do not exist due to large variability
- Regular assessment of growth and maturation is needed
- Key nutrients: energy, protein, iron, calcium, and vitamin D
- A balanced and healthful eating patterns is essential for long-term health, as well as developing a positive body image