CENTRE FOR
SPORTS AND EXERCISE
THE UNIVERSITY OF HONG KONG
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WHAT YOU SHOULD EAT AND DRINK TO HELP YOU COMPLETE YOUR DISTANCE EVENT

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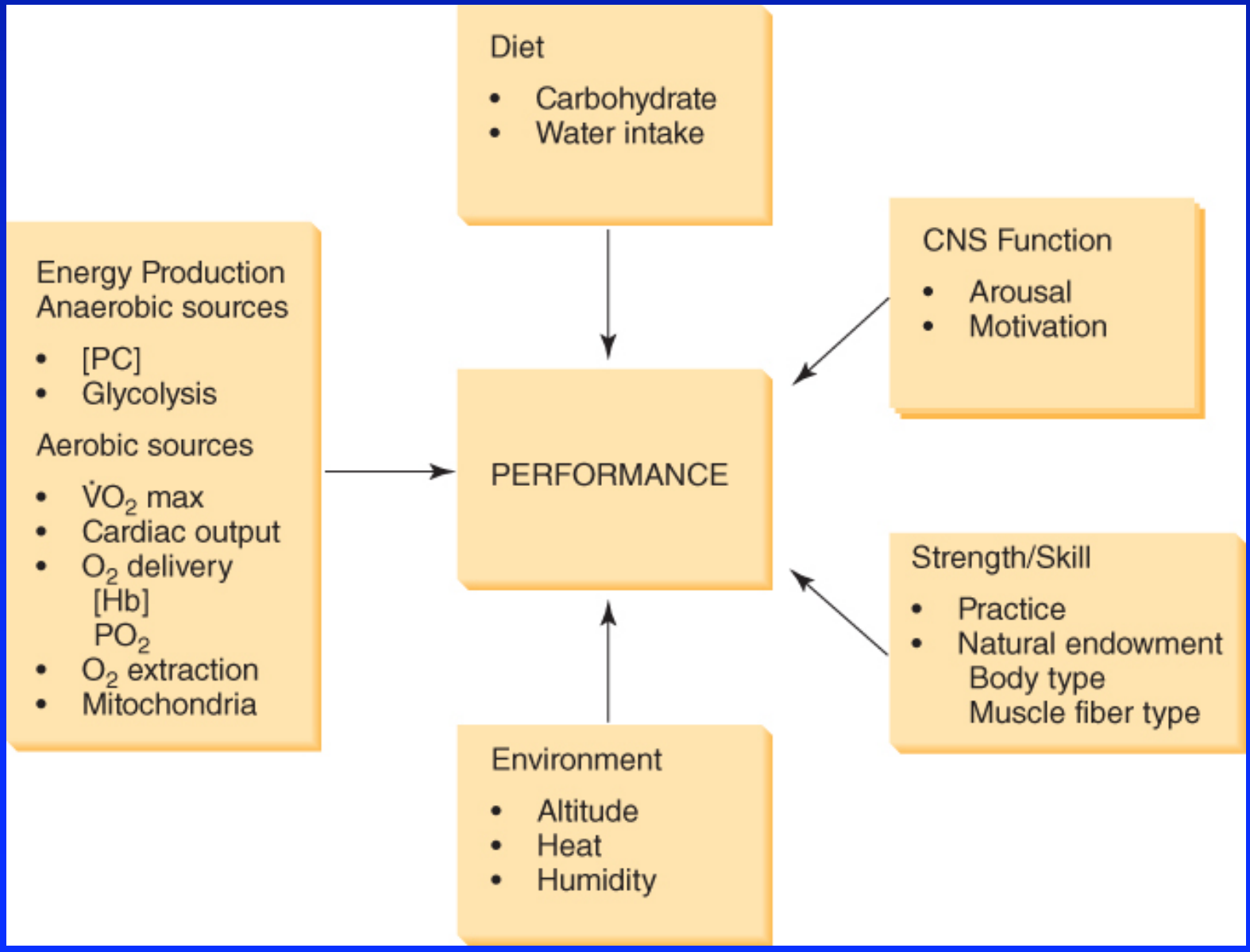
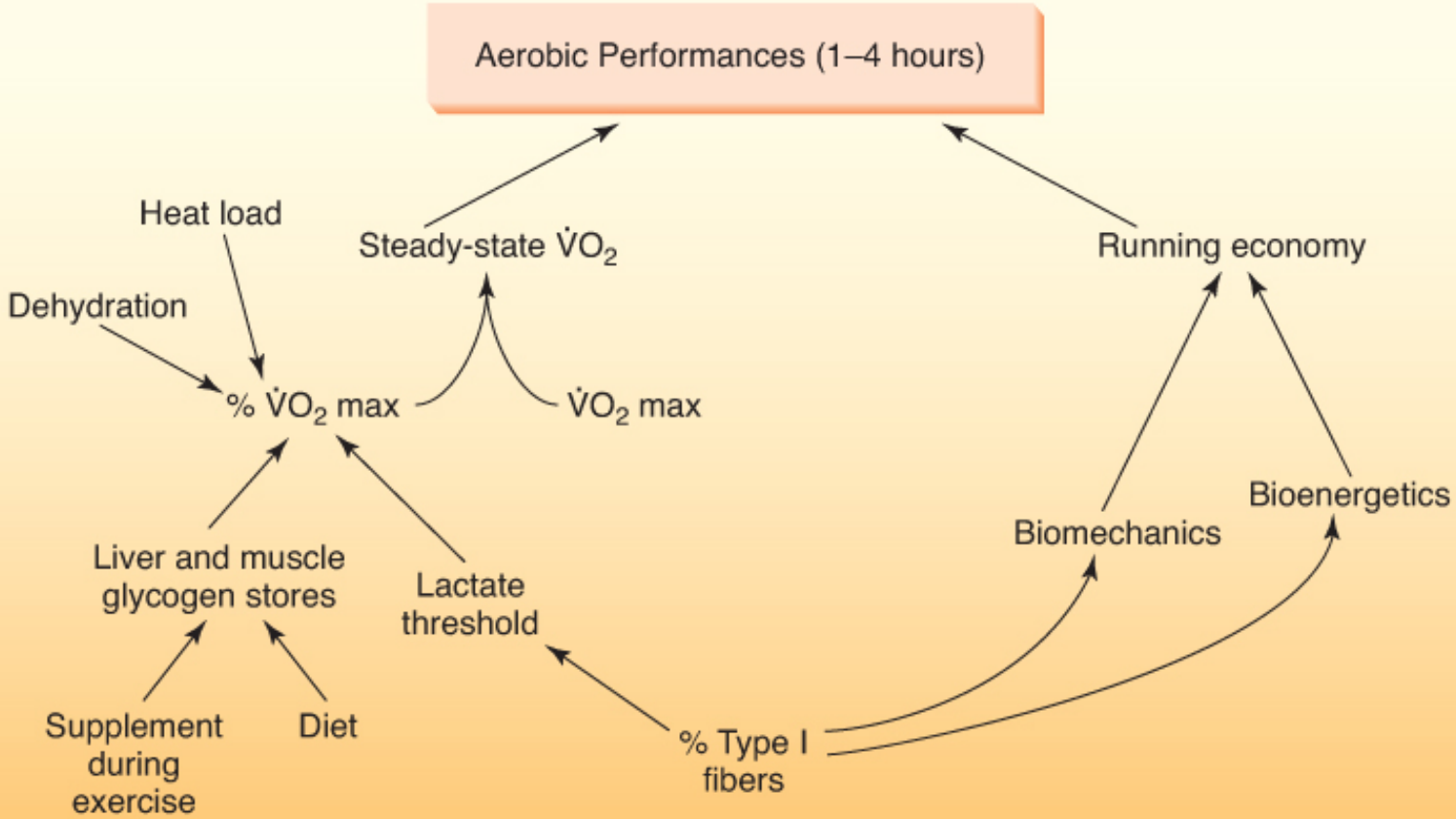
The participants will learn about

- factors that limit performance
- the importance of correct hydration
- how to balance CHO intake/fluid intake effectively during the race in relation to gastric emptying
- how to avoid dehydration v glycogen depletion
- what types of drinks may help or harm your performance
- simple ways to monitor fluid balance
- some thermal stress guidelines

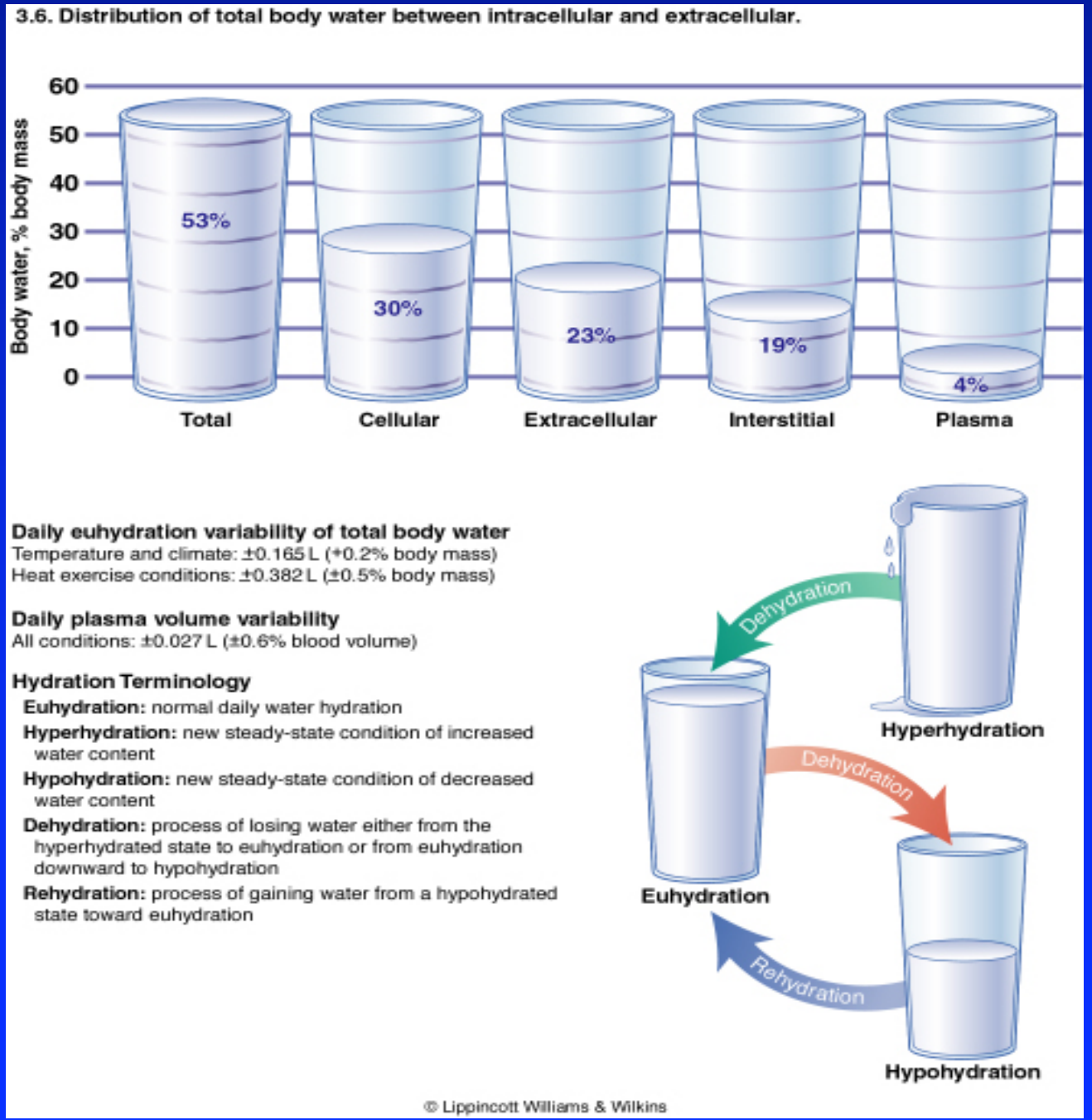
factors that limit performance

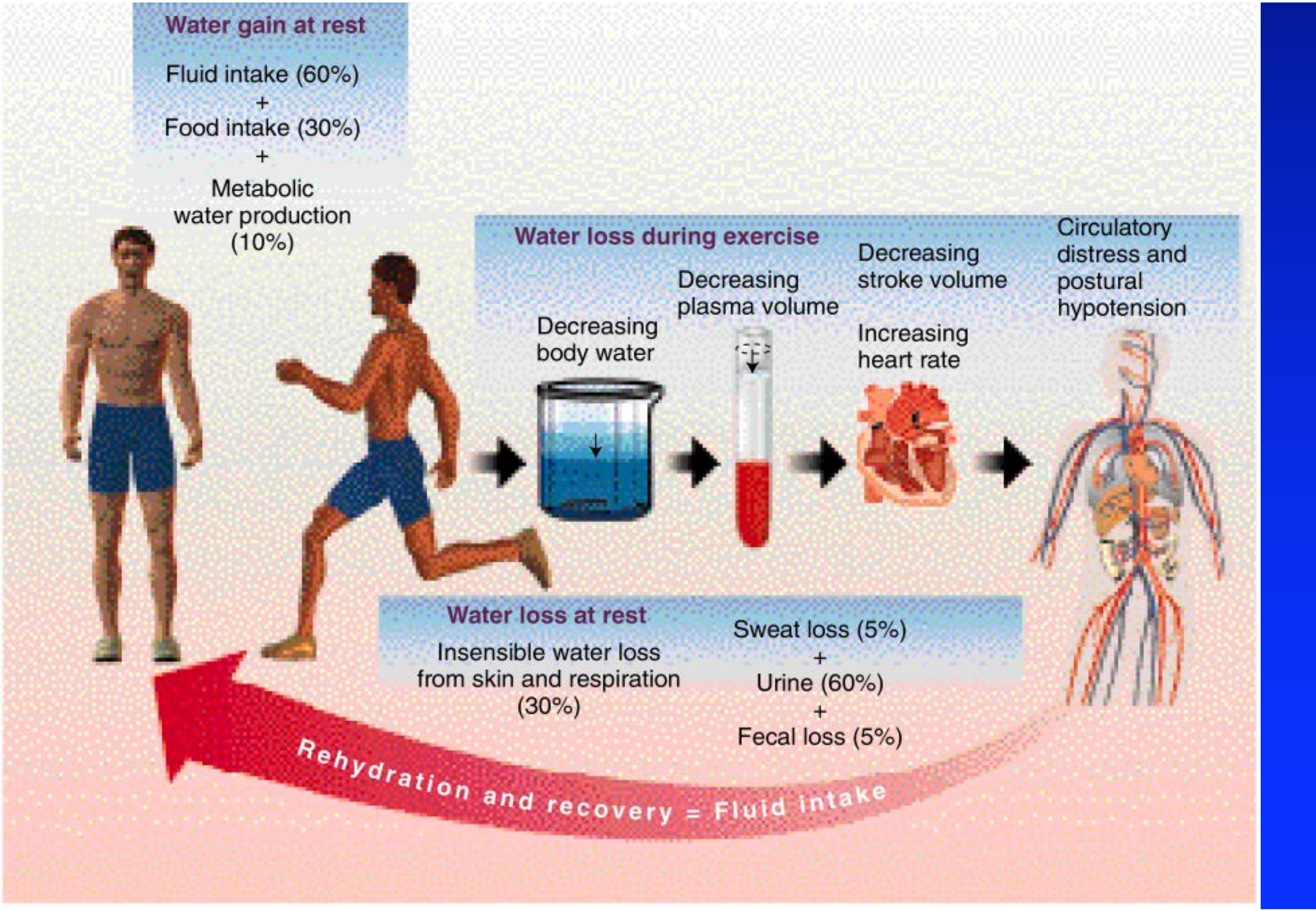


factors that limit performance

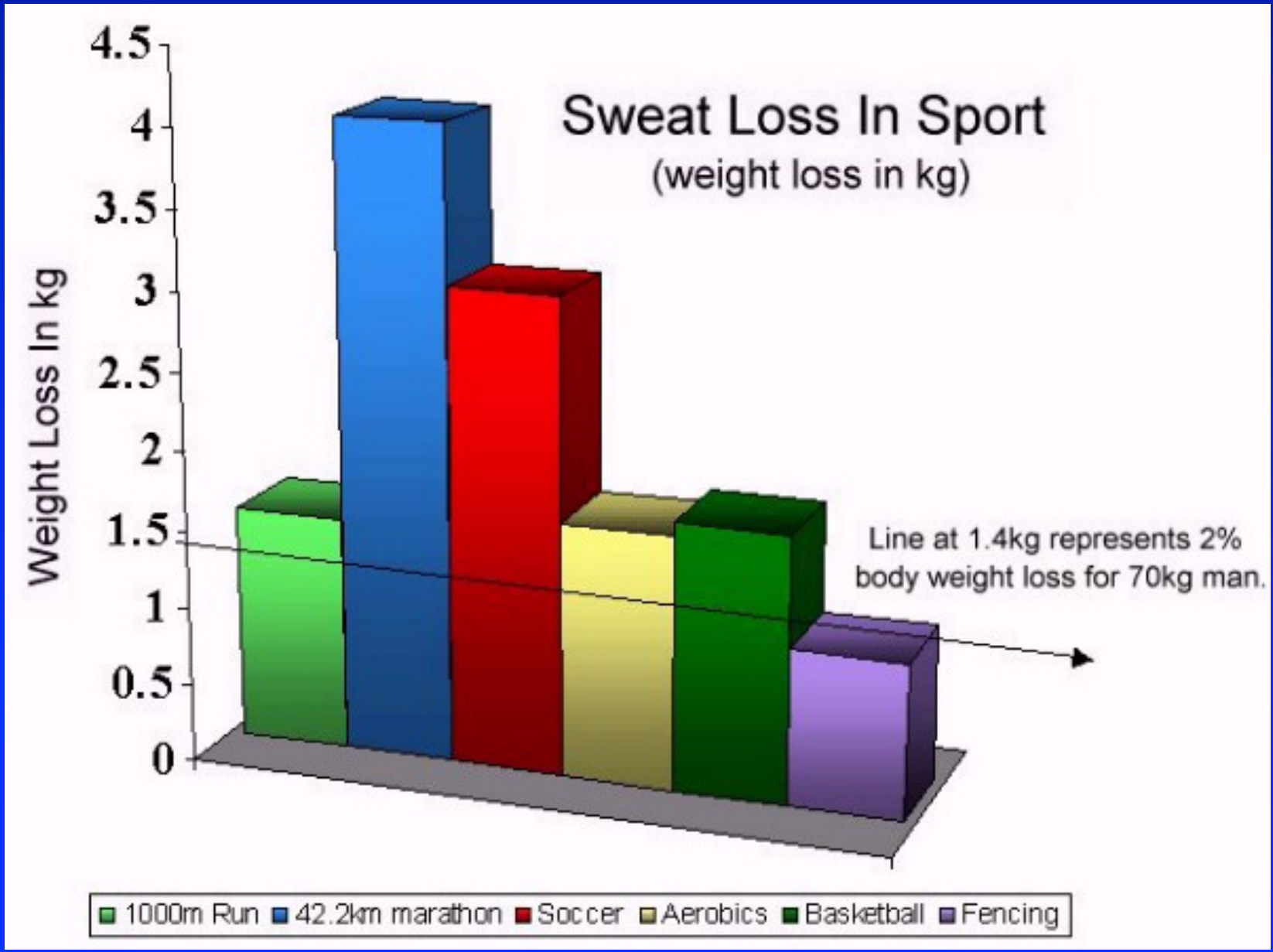


- terminology

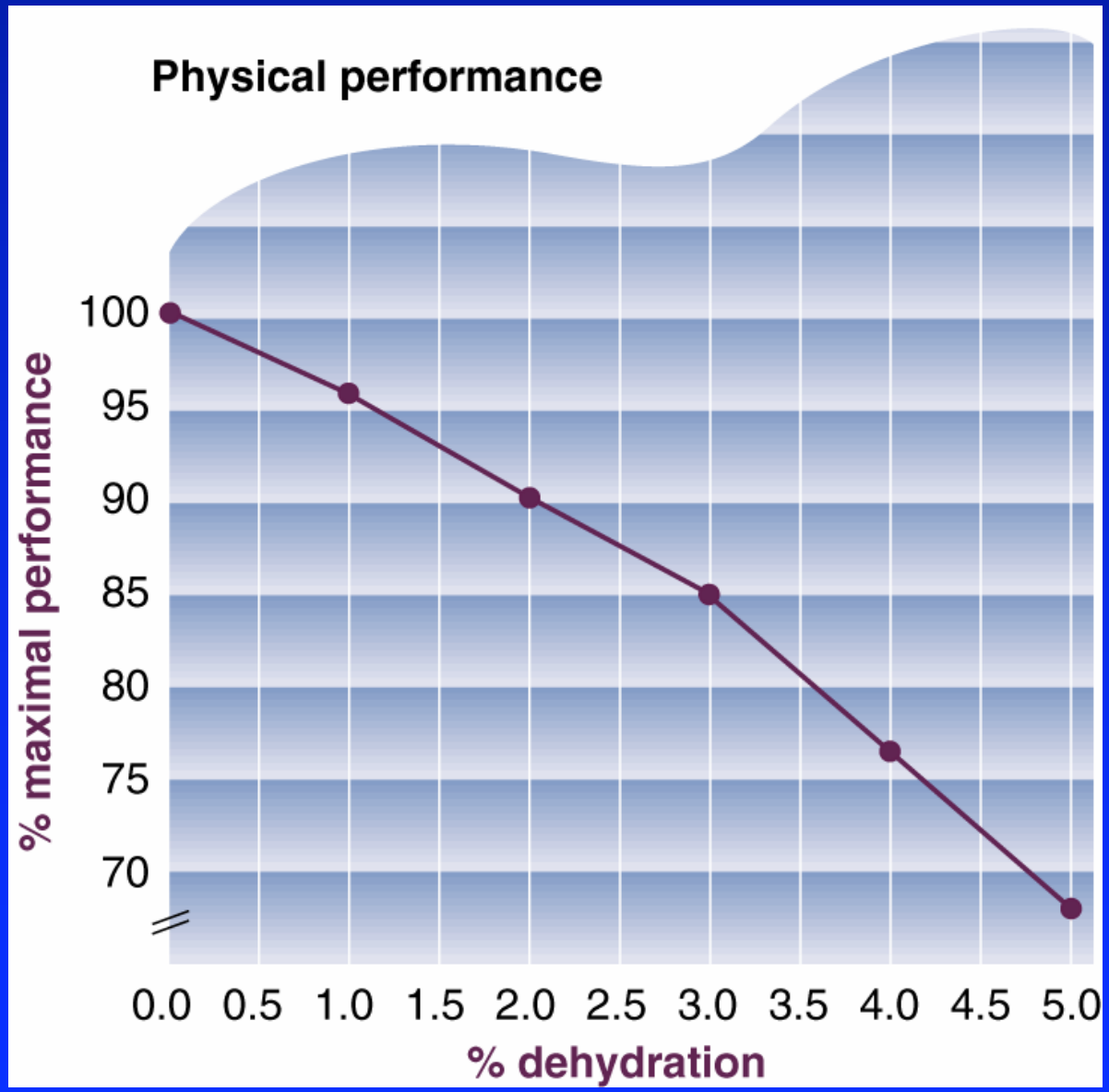



Water gain at rest
Fluid intake (60%)
+
Food intake (30%)
+
Metabolic water production (10%)
Water loss during exercise
Decreasing body water
Decreasing plasma volume
Decreasing stroke volume
Increasing heart rate
Circulatory distress and postural hypotension
Water loss at rest
Insensible water loss from skin and respiration (30%)
Sweat loss (5%)
+
Urine (60%)
+
Fecal loss (5%)
Rehydration and recovery = Fluid intake

- Sweat loss during exercise



- Sweat loss = dehydration = performance decrease



- Sweat loss during running can > 1-2 litres/hr

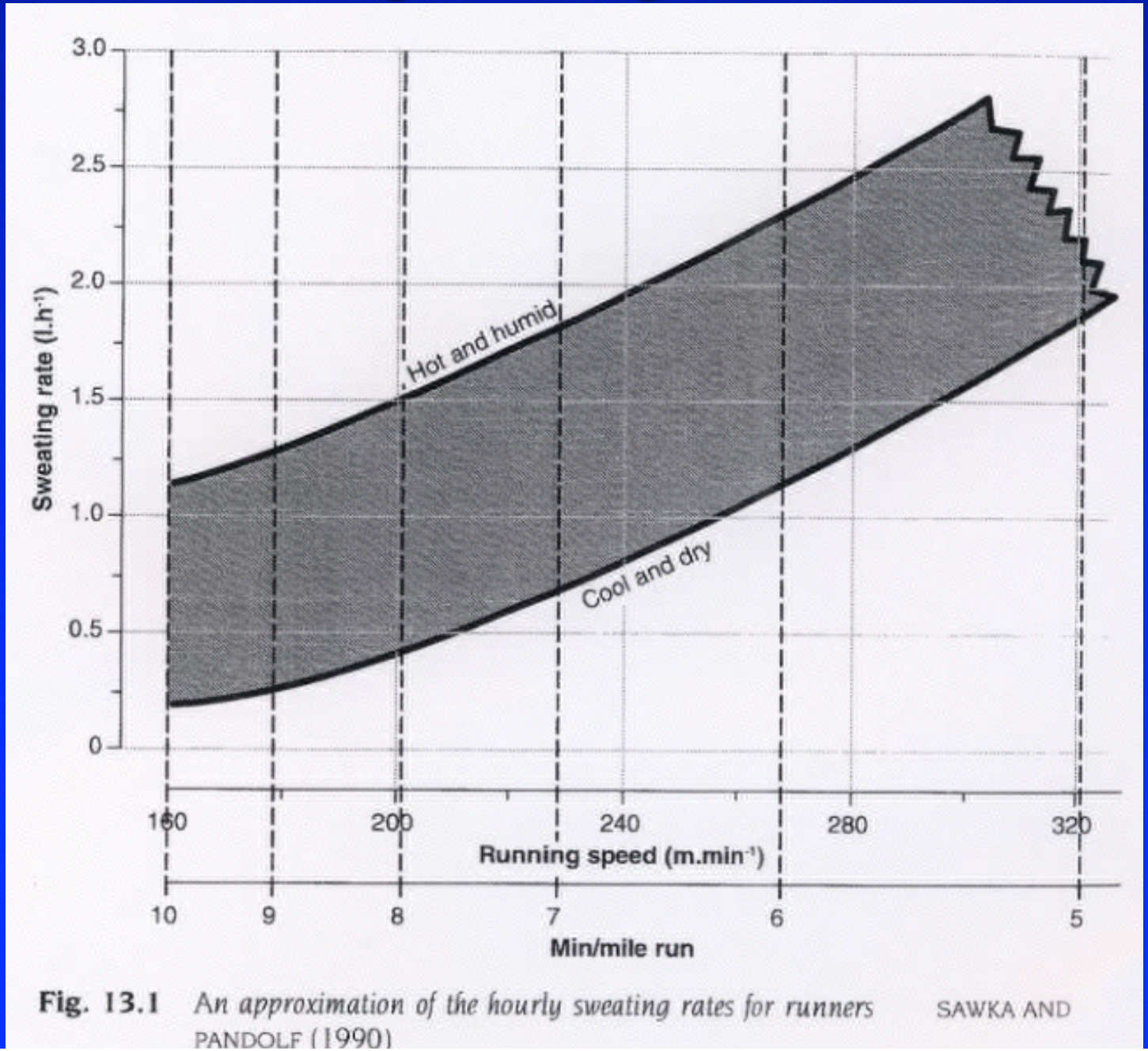


Fig. 13.1 *An approximation of the hourly sweating rates for runners* SAWKA AND PANDOLF (1990)

- How serious is sweat loss & dehydration

% body weight lost as sweat v Physiological Effect:

2% = Impaired performance

4% = Capacity for muscular work declines significantly

5% = Heat exhaustion

7% = Hallucinations

10% = Circulatory collapse and heat stroke

- Remember:
- we can monitor our fluid loss quite easily
- for every 1kg of body mass we lose, we generally will have sweated about 1 Litre of water
  - (1 litre of water weights 1 kg)
- Monitoring your weight regularly is important
  - Before and after long-run, and one-hour later
  - Try to ensure your weight is ~ constant

- Get that fluid in early and often:
- Dehydration can start within 15-20 minutes
- Fluid intake may not keep up with absorption rate – maximum repletion/replacement rate is about 4 cups per hour (1 litre)
- Even though a 1% fluid loss impairs performance
- Thirst may not “kick in” until 2% fluid loss – 1.5 litres (6 cups) for a 150-lb/65kg person
- Drink BEFORE you are thirsty!

Signs of Dehydration (and heat stress)

- Thirst, dry mouth
- Weakness, fatigue
- Nausea, vomiting
- High body temperature
- Muscle cramps – legs
- Dizziness, confusion
- Weak, rapid heart rate
- Lack of coordination & judgment

Hydrate morning, noon & night

- Plain water is OK for <60 minutes of exercise
- Sports beverages (fluid, carbohydrate and sodium) good for >60 minutes of exercise
- Carry fluid with you at all times!
- Pre- and During Run or Race:
  - Drink at least 500mls (2 cups) fluid 1-2 hours before run
    - Some suggest another 250mls 5-15 min before race starts
  - Drink 150-350ml fluid every 15-20 minutes during run
- Post-Run or Race:
  - Drink at least 1000ml (1litre) (4cups) fluid per kg lost
  - Drink until urine is pale or clear

Two MAJOR problems about marathons

- (1) Rate of sweat loss for many "serious" runners is GREATER than fluid can be replenished by drinking
  - Can sweat >2 litres/hr
  - But gastro-intestinal absorption is often limited to only 1.2-1.5 litres/hr (some dehydration must occur?)
- (2) Competition between getting into the body "sufficient Carbohydrates" v "sufficient Fluids"

(2) In a marathon you WILL run out of glycogen = stored carbohydrates, unless you run very slowly, or you eat during the race

- Glycogen depletion only affects marathon runners, NOT half-marathon/10K unless you are VERY slow/inefficient

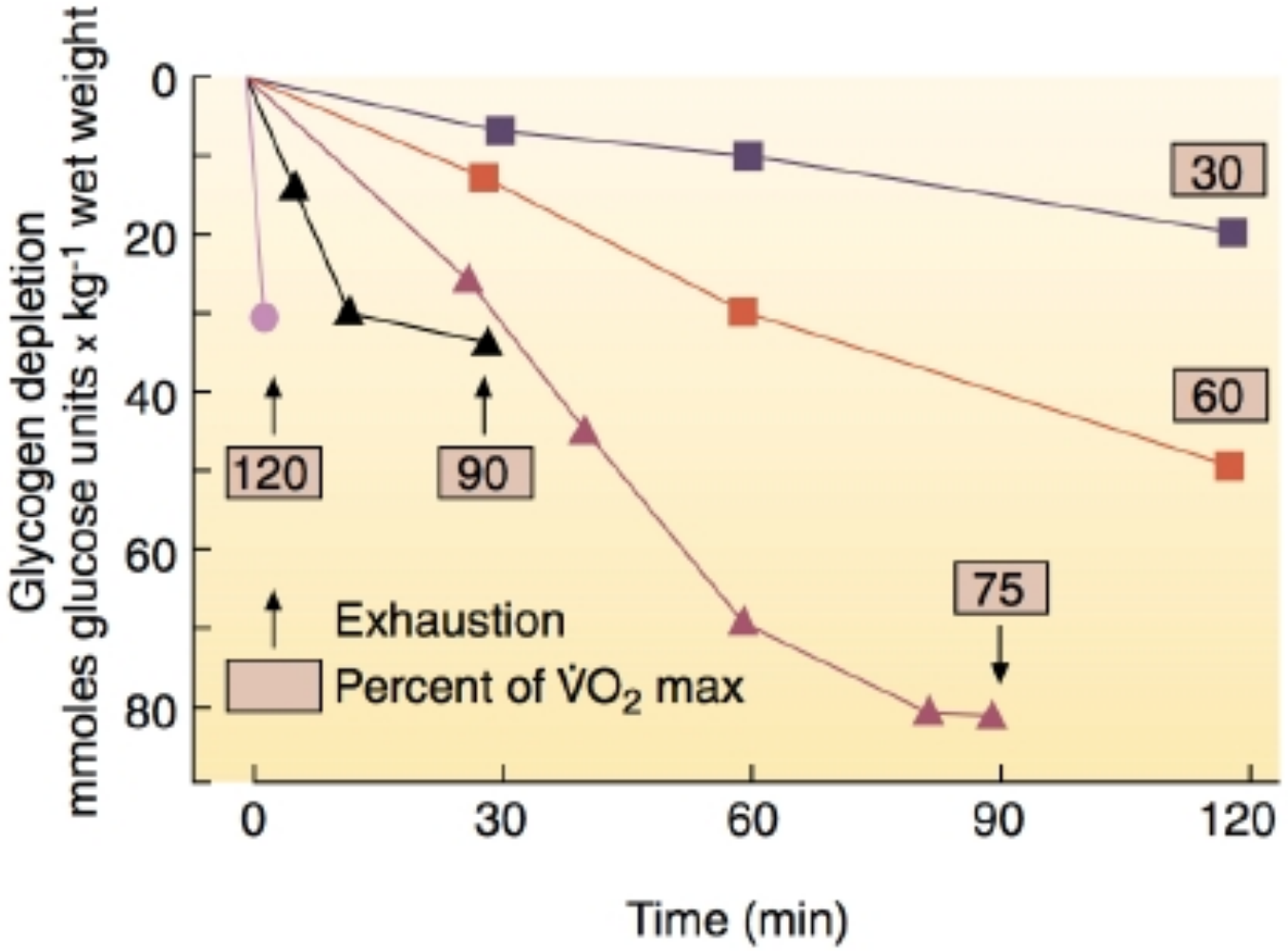


Figure 5.13

Glycogen depletion in the quadriceps muscle during bicycle exercise of increasing exercise intensities.

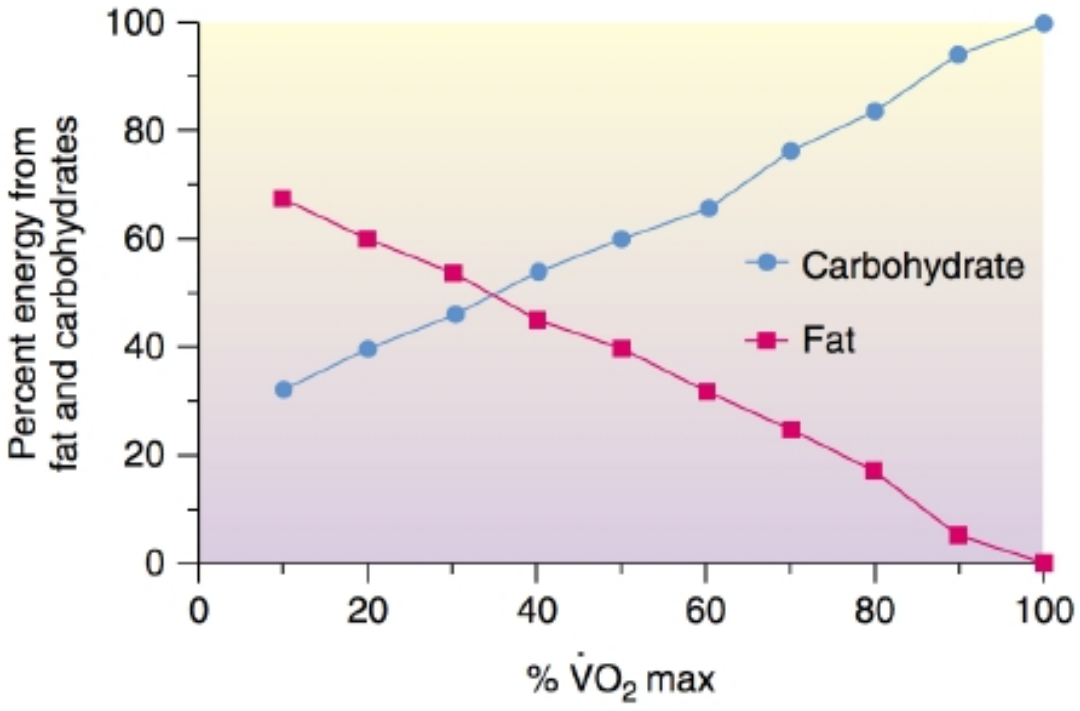


Figure 4.11
Illustration of the "crossover" concept. Note that as the exercise intensity increases, there is a progressive increase in the contribution of carbohydrate (CHO) as a fuel source.

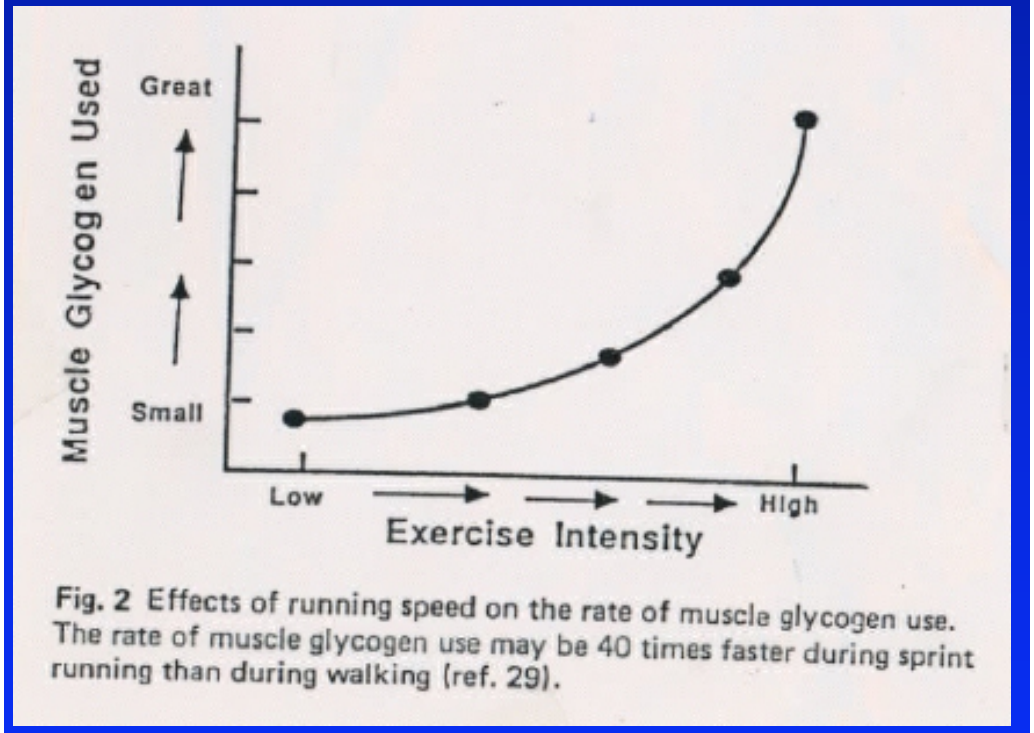
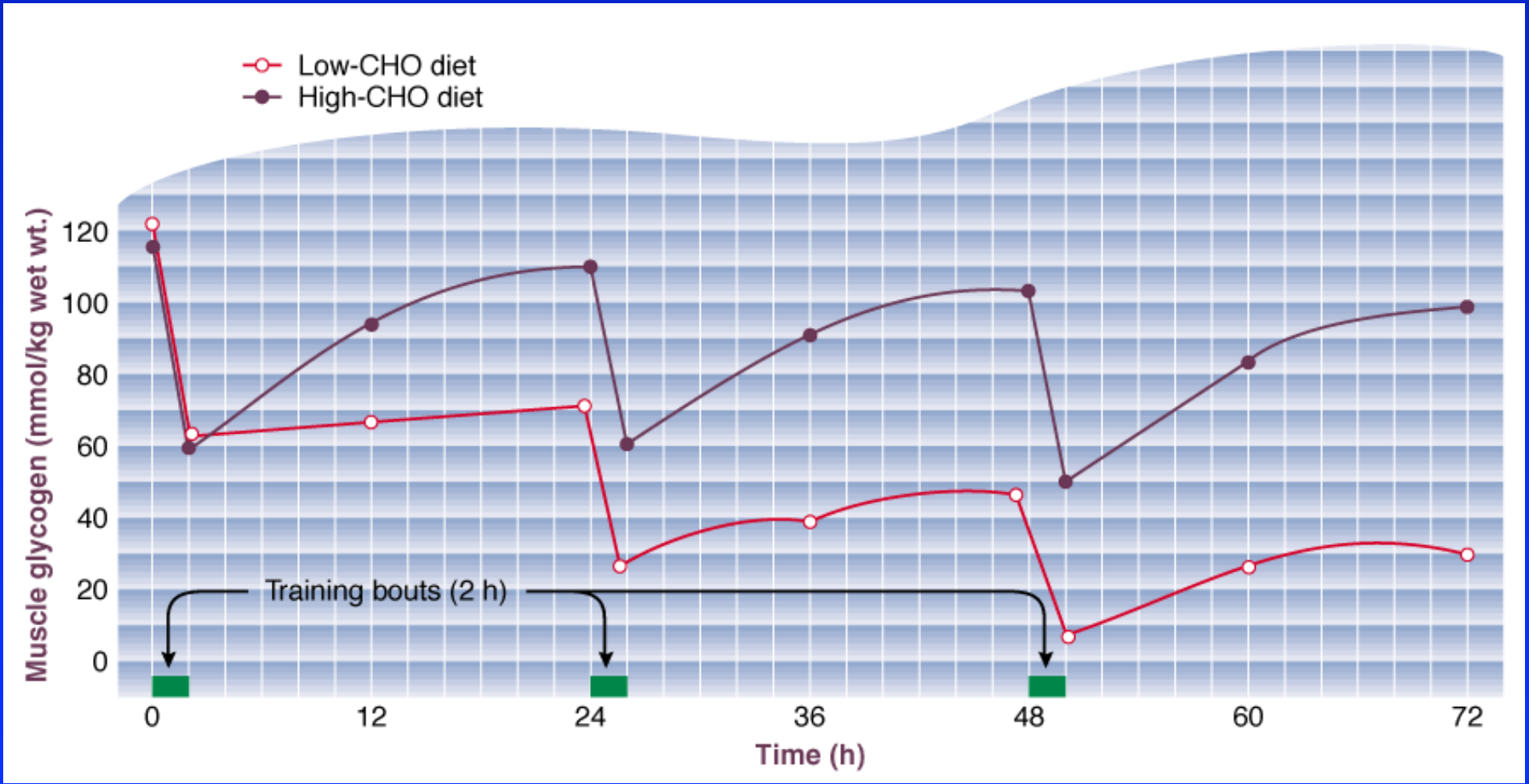


Fig. 2 Effects of running speed on the rate of muscle glycogen use. The rate of muscle glycogen use may be 40 times faster during sprint running than during walking (ref. 29).

- The faster you run – the faster you use your (limited) stores of carbohydrates/glycogen
- When glycogen is depleted = "race over" = very slow jog only (survivor-mode/plodding)

- So if carbohydrates will become low/depleted during the marathon – what can we do?
  - (i) Start the marathon with more glycogen stores = Yes
  - We can increase our liver and muscle glycogen by maintaining a medium-to-high carbohydrate diet (>50% of calories from ”complex carbs” – rice, noodles, pasta, potato, nuts, dried fruit, beans, grains/good-breads etc)

– A diet low in ”carbs” (<50%) = not wise during training as may limit your ability to recover and possibly lead to fatigue/exhaustion (compared to “high carb diet” >50%)



- So if carbohydrates will become low/depleted during the marathon – what can we do?
  - (ii) Load up on more carbs just before the race = Yes
  - Reduce - "taper" training intensity/volume, and increase carbs from 50% to 70% for 3 days before race-day
    - ideally you should practice this in training before the actual race to make sure you "feel OK"
    - NEVER NEVER NEVER do anything "new" on race day

- Taper training 5 days before ”race day”
- Increase 50% -> 70% carbs 3 days before
- Fully rest the day before + plenty of carbs

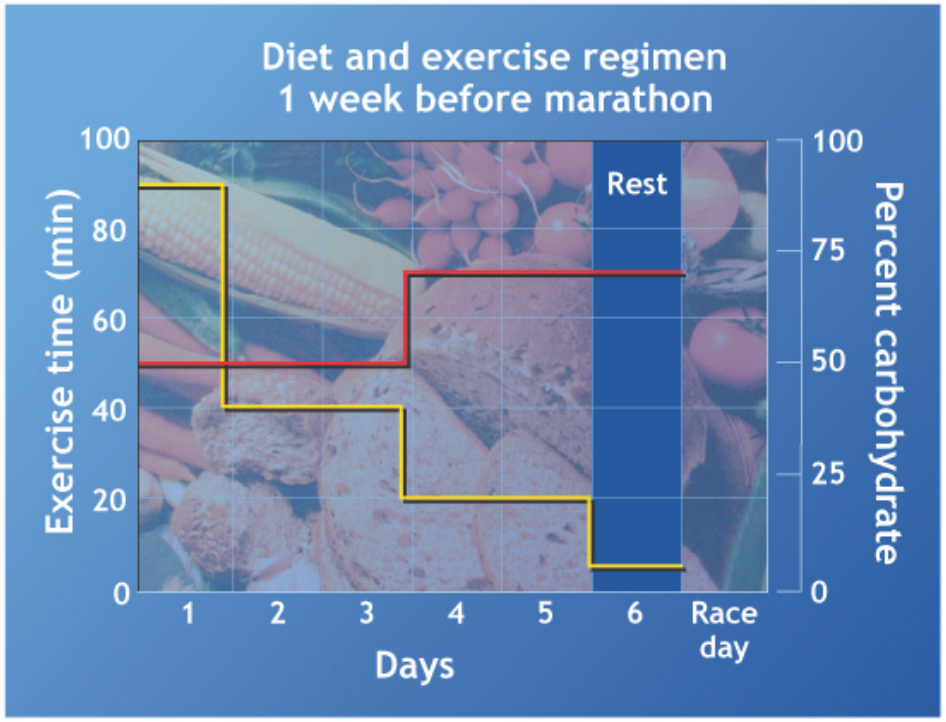
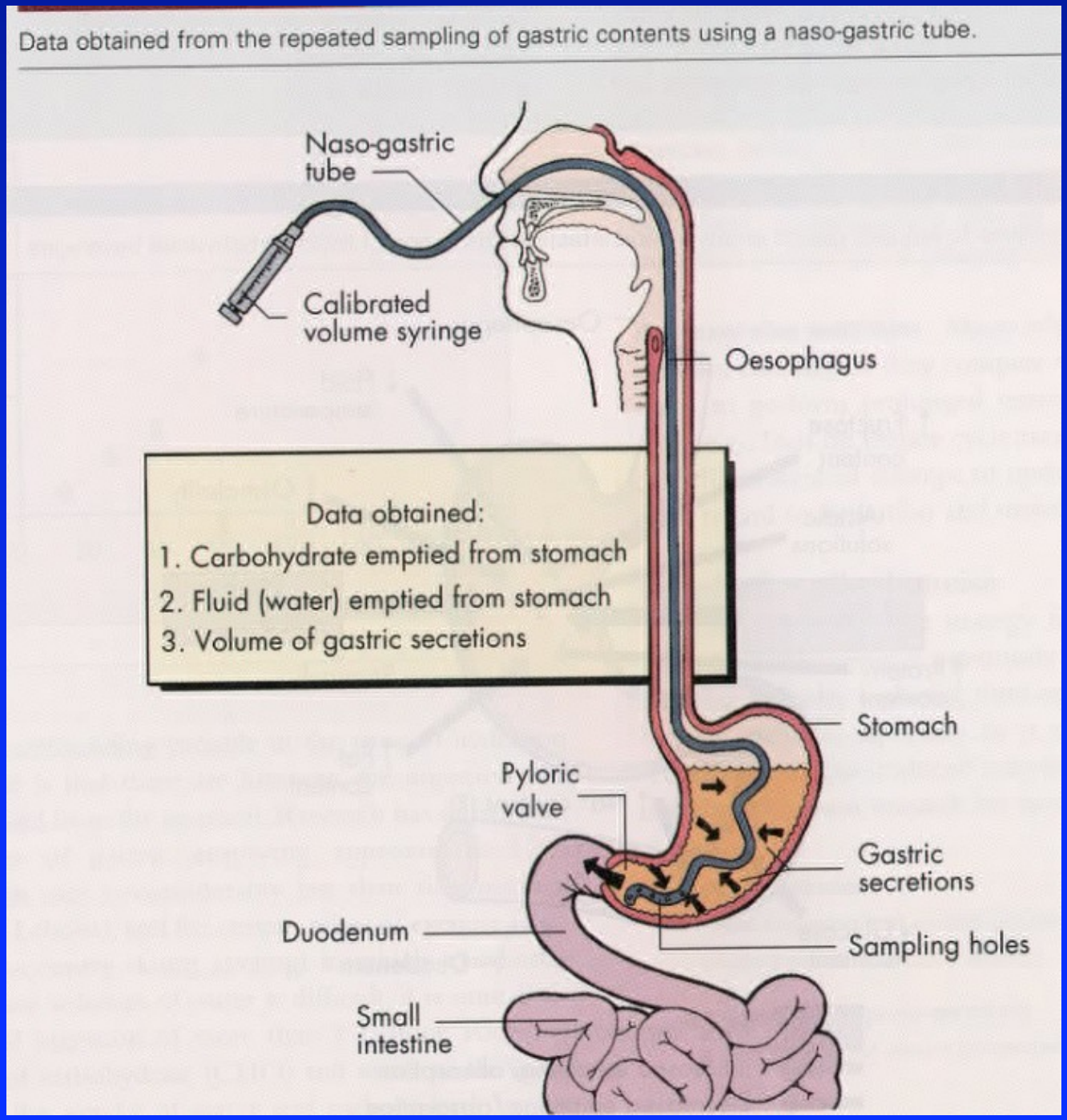


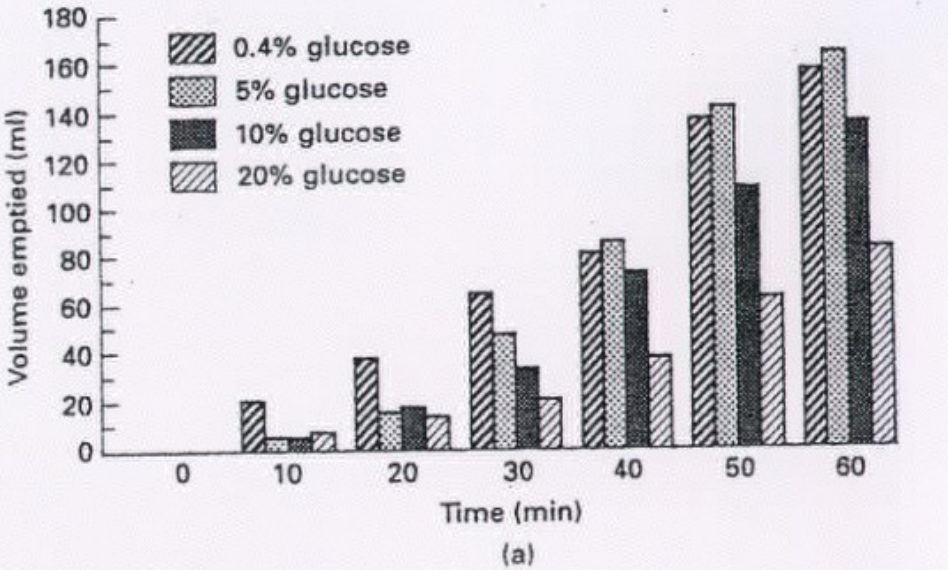
Figure 23.14 A modified approach to carbohydrate loading. Recommended combination of diet and exercise for overloading muscle glycogen stores in the week before an important endurance contest. Exercise time is gradually reduced during the week, while the diet's carbohydrate content increases for the last 3 days. (From Sherman WM, et al. Effect of exercise-diet manipulation on muscle glycogen and its subsequent utilization during performance. Int J Sports Med 1981;2:114.)

- So if carbohydrates will become low/depleted during the marathon – what can we do?
  - (iii) why not eat some bread/banana during race?
  - = problem; you can NOT eat and run!!

- So if carbohydrates will become low/depleted during the marathon – what can we do?
  - (iv) – why not drink some fruit juice/Coca-Cola/sugar drink with lots of carbohydrates for energy?
  - = problem: studies show, drinks with HIGH SUGARS in them, pass through your stomach (into small intestine for absorption) VERY SLOWLY = very slow water replenishment too!! (bad for rehydration)

Data obtained from the repeated sampling of gastric contents using a naso-gastric tube.





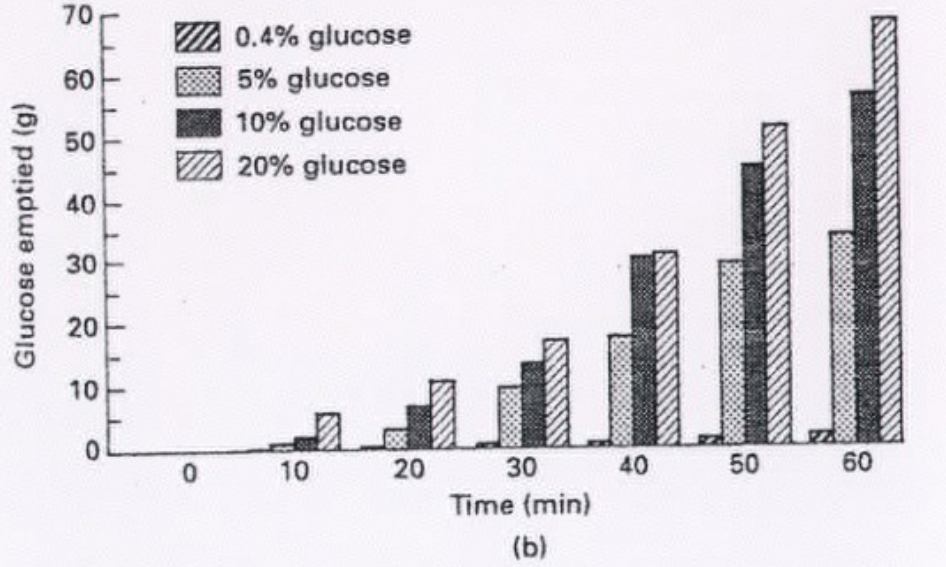


Fig. 1 Gastric emptying of flavoured water and glucose solutions of different concentrations after ingestion of a 200 ml drink: (a) the volume emptied; (b) the amount of glucose emptied. Measurements were made by scintigraphic imaging of technetium added to the drinks.

the top graph shows the volume of fluid emptied from the stomach (higher bars are better to prevent dehydration)
- which solution is emptied from the stomach into the intestines the fastest???

the lower graph above shows the volume of glucose emptied => higher bars are better (important if you are likely to run out of glycogen)
- which solution is best at emptying glucose from the stomach into the intestines???

- so does this show a conflict??

- low %CHO fluids are good for fluid delivery but poor for CHO delivery

- high %CHO fluids are good for CHO delivery but poor for fluid delivery

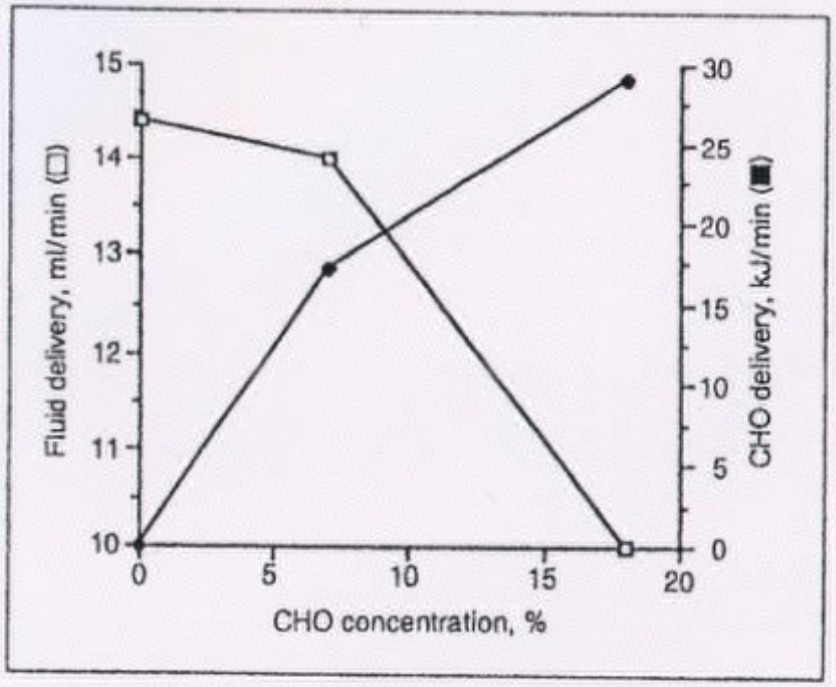
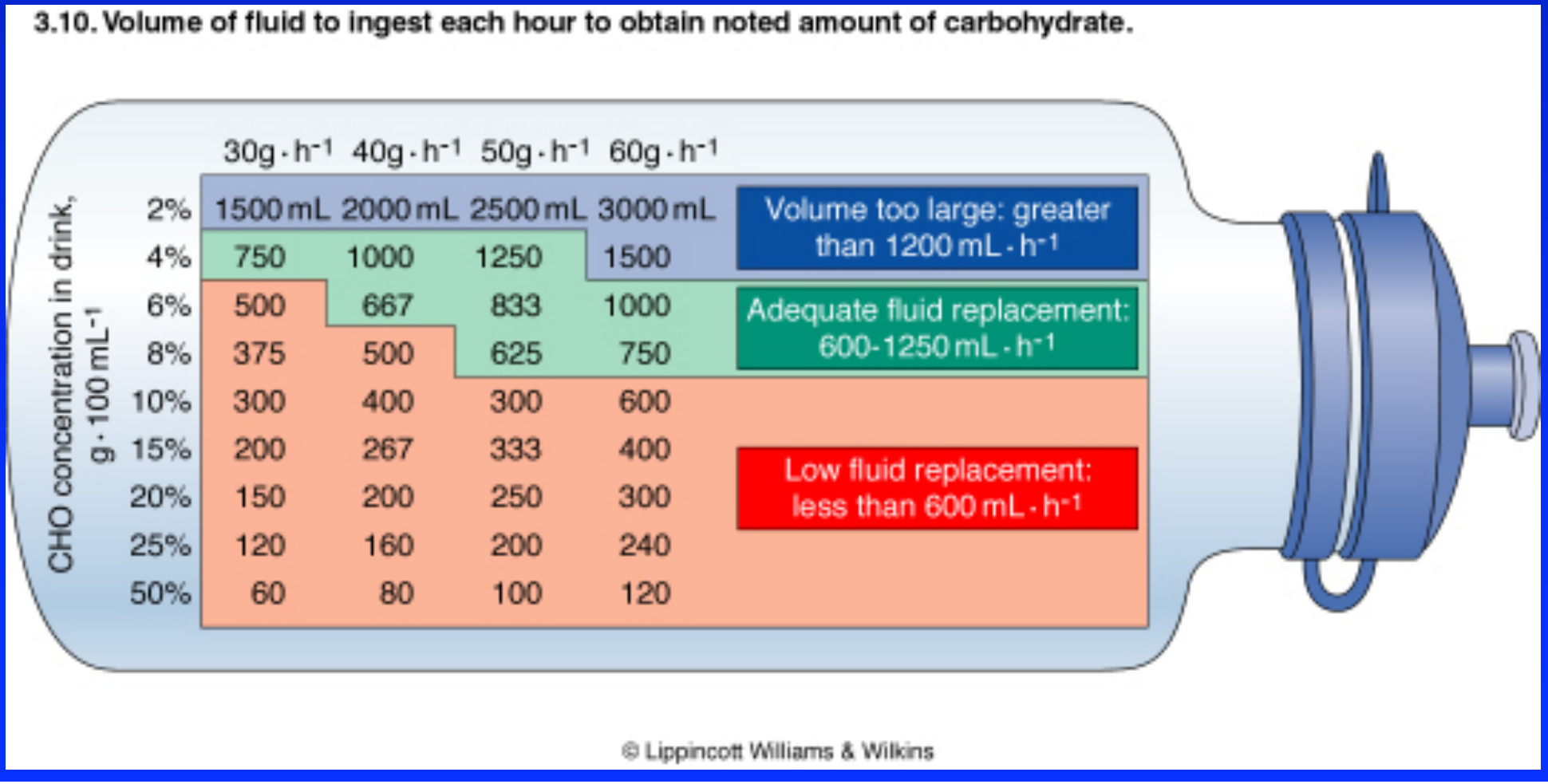


Fig. 4. Gastric emptying rates of CHO and fluid with solutions of different CHO concentration [data from 54, graphic design from 21].

- So water (no sugar) is absorbed VERY fast (but no CHO for energy)
- High CHO drinks are absorbed VERY slowly – but lots of energy
  - but poor fluid delivery to help prevent dehydration = bad
- Somewhere in middle is about BEST (about 6% sugar content)
- (% sugar: grape juice~16, orange/apple~10-12; Coke/Sprite~12; Gatorade~6)

- guideline below shows the combination of fluid volume and CHO% needed to deliver 30/40/50/60g CHO per hour
- <4%CHO means too much fluid (cannot absorb this)
- 4-6% - good balance (most good sports drinks around this)
- >10% = too little fluid for rehydration

3.10. Volume of fluid to ingest each hour to obtain noted amount of carbohydrate.



- So if carbohydrates will become low/depleted during the marathon – what can we use?
  - (v) – what drinks are best?

  - or "gels + water" are best?

  - it all depends what suits your stomach/taste best?
  - You MUST practice and try BEFORE the race

Guidelines for fluid replacement during the marathon

AIMS Association of International Marathons and Distance Races

Estimated finish time	Rate of fluid intake	Total fluid intake
< 4 hours	1000-12500ml/h	3.5-4 litres
4-5 hours	750ml/h	3-3.5 litres
> 5 hours	500-600ml/h	2.5-3 litres

ideal sports drink (according to Gatorade) =

- 6% CHO (>10% will decrease fluid delivery and have adverse osmolarity)
- mixture of at least 2-3 types of CHO seems to be beneficial (eg. sucrose, glucose, fructose); pure fructose is not recommended as it is slowly absorbed and can cause abdominal pain/diarrhoea
- at least 100mg Sodium per 8oz (250ml) of fluid [but not too much Sodium] (Na^+ increases the absorption of both fluid and glucose in the intestines, and retention of fluid "post exercise")
- some Potassium (28mg per 8oz/250ml fluid) to replace K^+ lost in sweat (but this is really only important in ultra-endurance events lasting several hours)
- no carbonation (can't drink "fizzy-drinks" as fast as non-carbonated drinks)
- no caffeine (caffeine is a diuretic, makes you urinate = lose water faster)
- tastes good (being cold helps)
- (isotonic/isosmotic is helpful)

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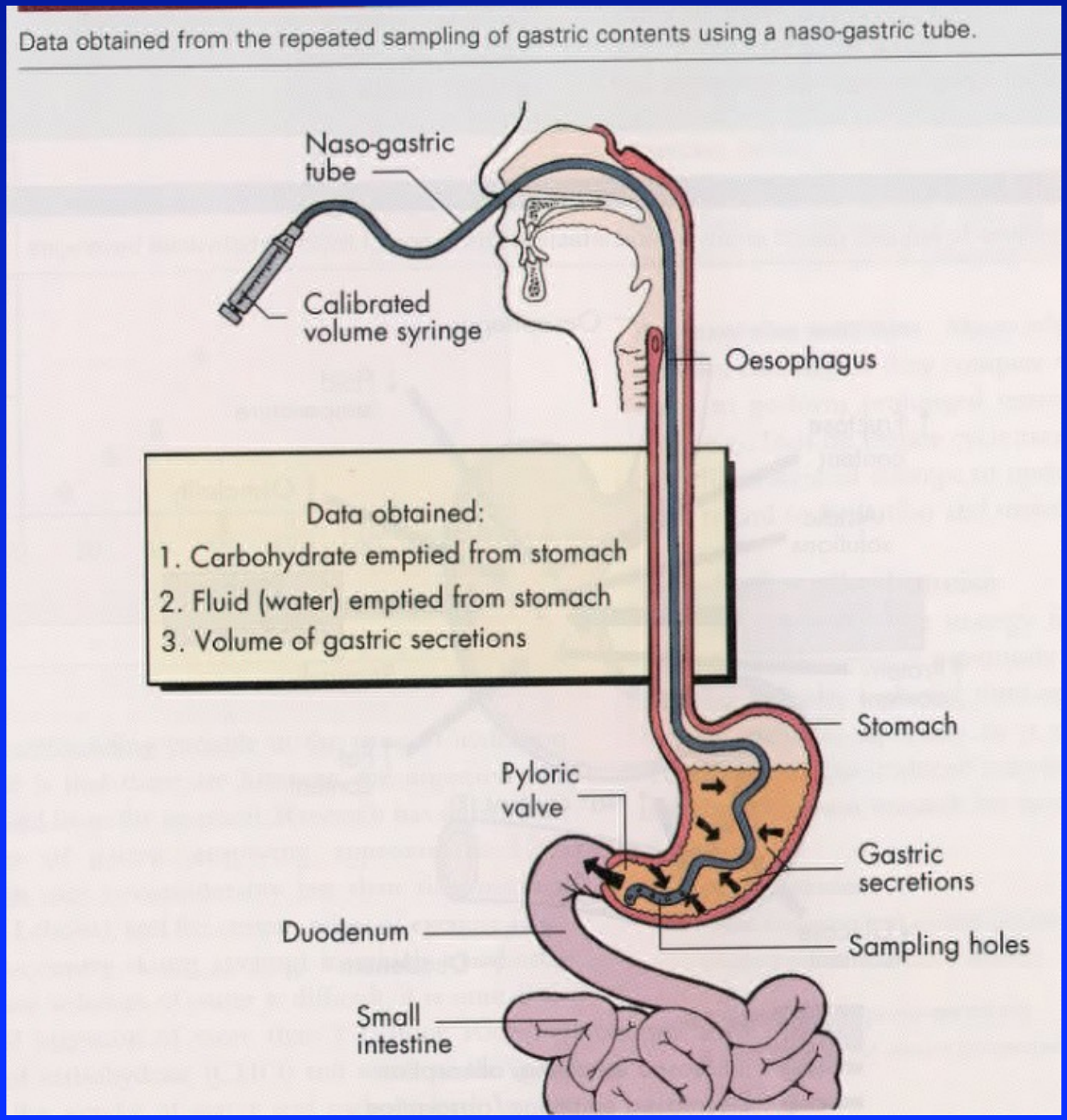
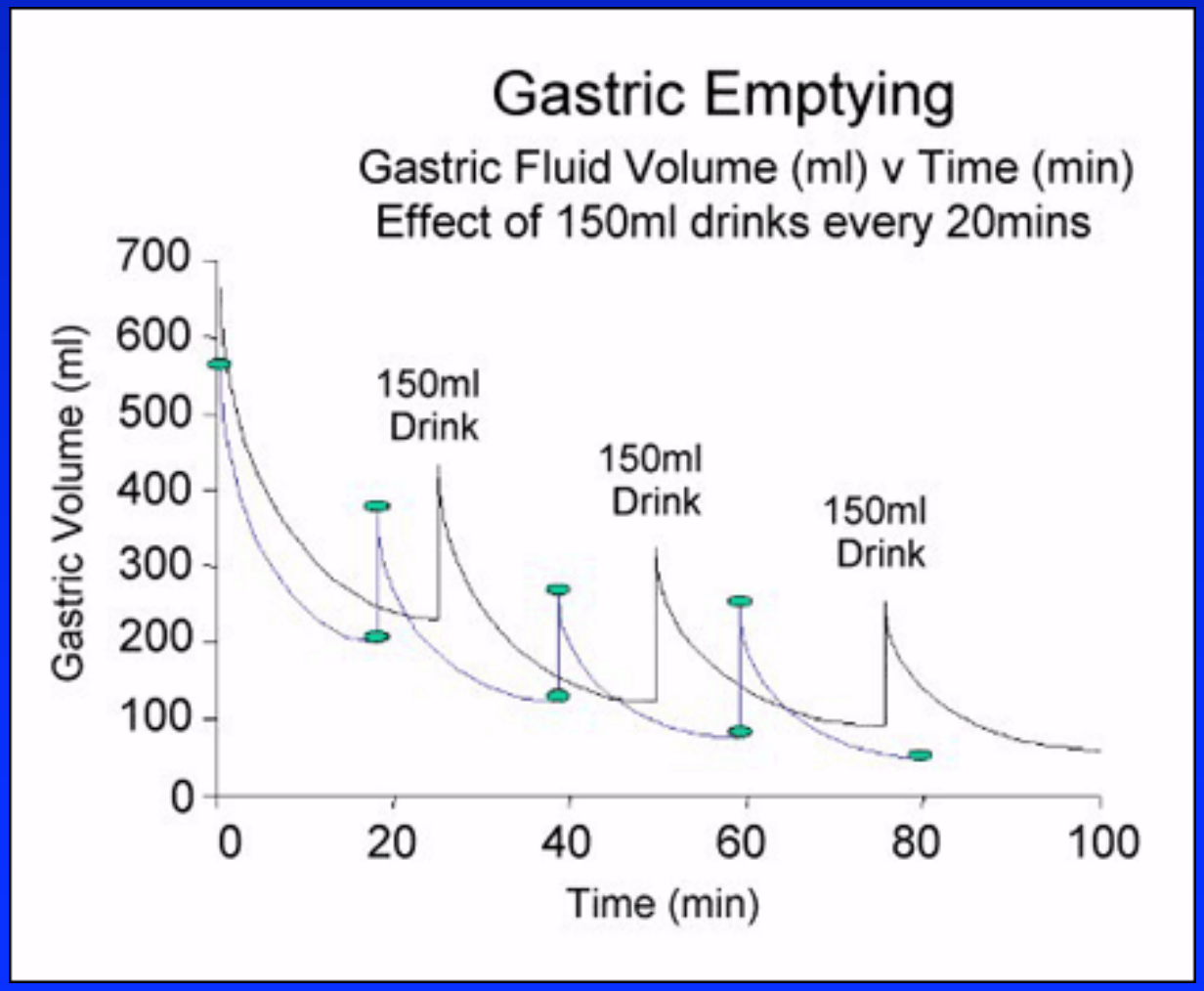


- Start with a "comfortably full" stomach and top-up volume by drinking small amounts regularly = this keeps "gastric emptying rate" HIGH = GOOD for rehydration
- = "many small drinks" is much better than "just a few large drinks"



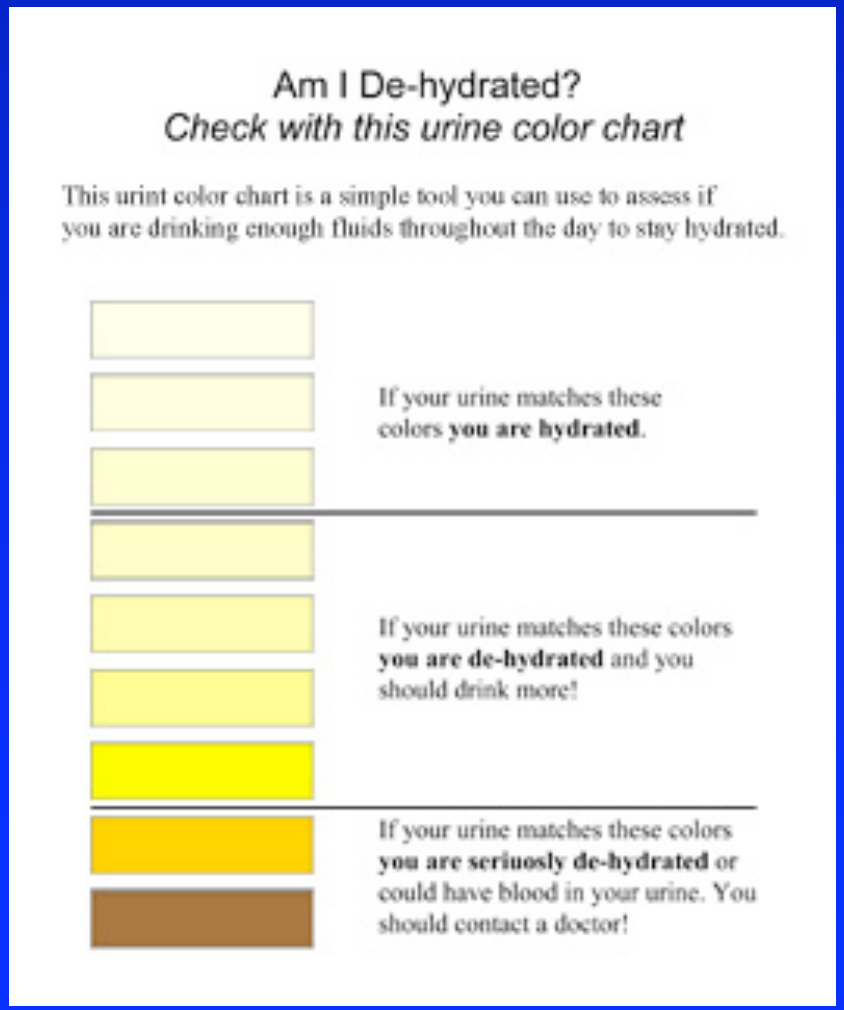
In this example, drinking 150ml every 20min was probably NOT enough to maintain hydration; typically >150-250ml every 15-20min is often suggested (depends on your size, pace, sweat rate etc)

- Other tips:

- Formulate your own individual strategy….
- Practise in training!
  - Amount of fluid/carbohydrate
  - Types (solutions, gels, temperature, type of container)
  - Brand (taste?)
  - Dose (how much) & frequency (how often)
  - Water intake (gels are very difficult to take without water; polymers/polycose may have some osmotic benefits?)
- Do not take salt tablets for cramps
- Practice drinking from cups (50% is lost?)
  - Use your own container? (hard to find! Need support team!)

- Other tips:

- Monitor hydration status via body weight, and urine volume & colour
- Urine volume ~1.8-2L/day
- Colour – see chart
  - (only if **not** taking vitamins)



- Other tips: Thermal stress

- Make sure you are in good condition/training/healthy/hydrated
- - wear good quality athletic clothes that do NOT absorb water (eg. Nike Dry-fit etc) and allow sweat to evaporate fast
- - start the event feeling "slightly chilled" as run will provide heat
- - if feeling heat stressed – slow down, stop, rehydrate FAST, seek help urgently
- RAPID and EARLY cooling is critical to surviving heat stress during long distance running in hot weather
- BEST way to cool is "tub-cooling" – cheap "plastic children's pool-tub" – fill with ice & water, have towels to sponge limbs/neck/elevate feet; get medical help urgently

Other tips: Thermal stress

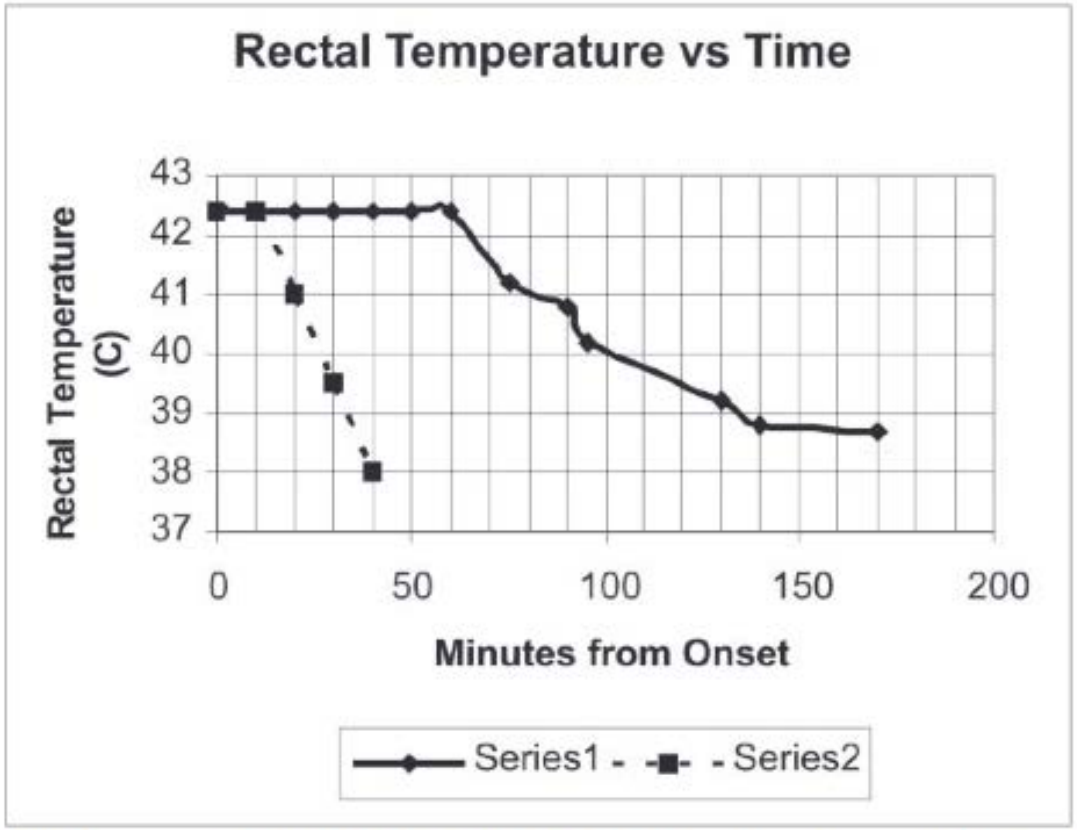


Fig. 1 *– Composite EHS treatment cooling curves for runners identified at the finish line who all lived (Series 2) and football players who were not immediately identified who all died (Series 1). The area under the cooling curve for series 1 is approximately 50 degree-minutes and for series 2 is approximately 200 degree-minutes. Series 1 athletes where cooled with fans and water sponging in emergency rooms and series 2 athletes where cooled in medical tents with tub immersion.*

Fig. 2 *– Immersion in an tub of ice water for EHS treatment*

(Photo courtesy of William O Roberts MD)

Summary and Recommendations

Fluid/CHO intake:

- Measure individual sweat rate during training *at race pace* by weighing before and after run.
- Sports drinks are preferable to water alone (due to CHO ~6%).
- Thirst may be an inadequate mechanism especially during warm/hot weather.
- Practice your drinking/CHO strategy in training (type of drink, amount, frequency, method). *Do not* try anything new on race day.
- Ensure that you start the race in a good glycogen + hydration state.
- When you have an established drinking/CHO strategy, check it with pre- and post-race weighing (best to practice before).