

Fluid Management in Exercise

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Water in the Body

- # 45 – 60% of total body mass
- # 65 – 75% of muscle weight
- # 10% of fat mass

Variables

- # Age
 - # Gender
 - # Body composition
-

Role of Body Water

- # Nutrient transport medium
 - # Chemical reaction medium
 - # Waste product excretion
 - # Joint lubricant
 - # Organ cushioning – heart, lungs, intestines, eyes
 - # Body structure and form
 - # Thermoregulation
-

Fluid Balance

Temperate Weather/Little Exercise

Input (mL)

Food 1000

Fluids 1200

Metabolism 350

Total 2550

Output (mL)

Urine 1250

Faeces 100

Skin 850

Lungs 350

Total 2550

Fluid Balance

Hot Weather/Heavy Exercise

Input (mL)

| | |
|--------------|------|
| # Food | 1000 |
| # Fluids | 1200 |
| # Metabolism | 350 |

Total 2550

Output (mL)

| | |
|----------|------|
| # Urine | 500 |
| # Faeces | 100 |
| # Skin | 5000 |
| # Lungs | 700 |

Total 6300

Fluid Loss Factors

- # Genetics
 - # Body Size
 - # Fitness
 - # Environment
 - # Exercise Intensity
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Fluid Replacement

Why?

- # Meet water needs
 - # Reduce heat stroke risk
 - # Improve performance by preventing or reducing dehydration
 - # Provide convenient way of consuming carbohydrates
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Fluid Replacement Issues

- # Typical replacement of losses = 30 – 70%
 - # Thirst = dehydration
 - # Low sodium fluids switch off thirst too early
 - # Not natural during sport
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Dehydration

Effects

- # Reduced work capacity
 - # Reduced mental function and co-ordination
 - # Decreased blood volume
 - # Increased heart rate
 - # Impaired body temperature control
 - # Exhaustion
 - # Heat stroke
 - # Shock
 - # Death
-

Dehydration

| Body Weight | 2% Loss | 5% Loss |
|--------------------|----------------|----------------|
| 60kg | 1.2kg | 3.0kg |
| 75kg | 1.5kg | 3.75kg |
| 90kg | 1.8kg | 4.5kg |

Dehydration

Urine Analysis

Urine colour most accurate hydration indicator

Well-hydrated Pale and clear

Dehydrated Dark and yellow
Decreased volume

Sweat Loss

1. Weigh before and after training
2. Monitor volume of fluid consumed during training
3. Determine change in body mass before and after any toilet stops

$$\# \text{ Sweat loss (L)} = \text{Change in body mass (kg)} \\ + \text{Fluid intake (L)} \\ - \text{Urine losses (L)}$$

Sweat Loss

Example

| | |
|-----------------------------|---------------------------|
| # Pre-exercise weight (kg) | 65.0kg |
| # Post-exercise weight (kg) | 63.5kg |
| # Fluid consumed (L) | 1.0L |
| # Exercise duration (hr) | 2hrs |
| # Fluid loss (L) | $65.0 - 63.5 = 1.5$ |
| # Total sweat loss (L) | $1.5 + 1.0 = 2.5$ |
| # Sweat rate (L/hr) | $2.5/2 = 1.25\text{L/hr}$ |

Fluid Replacement

1. Total weight loss (kg) =
weight (before training) – weight (after training)
2. Total fluid required (L) =
total weight loss (kg) x 1.5

Fluid Replacement

Example

| | |
|-----------------------------|------------------------|
| # Pre-exercise weight (kg) | 63.0 |
| # Post-exercise weight (kg) | 62.4 |
| # Total weight loss (kg) | $63.0 - 62.4 = 0.6$ |
| # Total fluid required (L) | $0.6 \times 1.5 = 0.9$ |

Electrolyte Balance

| | Plasma (mmol/L) | Sweat (mmol/L) | Intracellular (mmol/L) |
|------------------|----------------------------|---------------------------|-----------------------------------|
| Sodium | 137 – 144 | 40 – 80 | 10 |
| Potassium | 3.5 – 4.9 | 4 – 8 | 148 |
| Calcium | 4.4 – 5.2 | 3 – 4 | 0 – 2 |
| Magnesium | 1.5 – 2.1 | 1 – 4 | 30 – 40 |
| Chloride | 100 – 108 | 30 – 70 | 2 |

Hyponatraemia

Definition

- # Extreme sodium loss through prolonged sweating, coupled with dilution of existing extracellular sodium from consuming fluids with low or no sodium
 - # Low sodium drinks include water, fruit juice, cordial and fizzy drinks
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Hyponatraemia

Effects

Mild

- # Headaches
- # Confusion
- # Weakness
- # Nausea
- # Cramps

Severe

- # Seizures
 - # Coma
 - # Pulmonary oedema
 - # Death
-

Cramp

Possible Mechanisms

- # Poor fitness
 - # Over-training
 - # Inadequate stretching
 - # Dehydration
 - # High sodium losses
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Sports Drinks

- # Carbohydrate concentration
 - # Type of carbohydrate
 - # Osmolality
 - # Electrolyte composition
 - # Electrolyte concentration
 - # Flavouring components
-

Sports Drinks

Carbohydrate Benefits

- # Promotes fluid absorption
 - # Provides fuel for working muscles (before and during exercise)
 - # Replenishes glycogen stores (after exercise)
 - # Reduces recovery time
 - # Low bulk
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Sports Drinks

Sodium Benefits

- # Promotes fluid absorption
 - # Promotes carbohydrate absorption
 - # Promotes fluid retention
 - # Stimulates thirst
 - # Prevents hyponatraemia
-

Sports Drinks

Ideal Composition

| | 100mL | 1000mL |
|---------------------------------|--------------|---------------|
| Carbohydrate g | 4.0 – 8.0 | 40 – 80 |
| Sodium mg | 50 – 70 | 500 – 700 |
| mmol | 2.0 – 3.0 | 20 – 30 |

Type of Carbohydrate

- # Glucose
 - # Glucose polymers
 - # Maltodextrin
 - # Sucrose

 - # Avoid fructose
-

Ideal Sports Drinks

Per 100mL

| | Horley's® Replace | pB® Fluid & Electrolyte Replacement |
|-----------------------------|------------------------------|--|
| Energy (KJ/Kcal) | 125 / 30 | 109 / 26 |
| CHO (g) | 7.5 | 6.8 |
| Fat (g) | 0 | 0 |
| Protein (g) | 0 | 0 |
| Sodium (mg) | 46 | 58 |

Sports Water

- # Colour-free
 - # Lightly flavoured
 - # Low energy
 - # Vitamins and/or electrolytes
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- # Marketing – better than plain water but with less calories than sports drinks
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- # Examples – Mizone, H2Go
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Sports Water

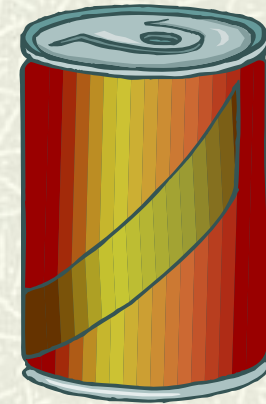
Bottom Line

- # No substitute for sports drinks
 - # Consume during low to moderate intensity exercise up to 60 – 90 minutes
 - # Consume during exercise where plain water would be appropriate
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Fizzy Drinks

- # 10 – 12 % carbohydrate
- # Very low sodium
- # Fizz → gut problems
nausea, bloating, diarrhoea
- # Caffeine → ↑ urine → dehydration

- # Diet soft drinks = no carbohydrate



Fruit Juice and Cordial

- # 8 – 12% carbohydrate
- # Slow absorption
- # Slow replacement of glycogen stores
- # Low sodium



Drinks with Caffeine

- # Coffee, tea, fizzy, cocoa, energy drinks
- # Caffeine → ↑ urine → dehydration

Negative Effects

- # ↓ co-ordination
- # Nervousness
- # Insomnia
- # Tremors



Alcohol

Negative Effects

- # Decreased reaction time, balance, co-ordination, accuracy, concentration, decision making
 - # Blurred vision
 - # Behaviour changes
 - # Dehydration
 - # Fatigue
 - # Impaired temperature control
 - # Delayed injury healing
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Alcohol

Sensible Intake

- # Rehydrate with water and sports drinks
 - # Wait till urine is clear before drinking alcohol
 - # If injured, avoid alcohol for at least 24 hours
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Pre-event Fluids

- # 300 – 600mL with pre-event meal
 - # 150 – 300mL every 15-20mins up until 45-60mins prior to event
 - # Water is adequate – short events
 - # Sports drinks assist in meeting fluid and carbohydrate needs and may help with fluid retention
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Exercise < 30 minutes

- # Begin exercise in well-hydrated condition
 - # Correct any hypo-hydration due to deliberate dehydration
 - # Fluid ingested during event will not benefit performance
 - # Rehydrate between sessions to avoid progressive dehydration
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Exercise 30 – 60 minutes

- # Begin exercise in a well-hydrated condition
 - # Use a fluid replacement plan
 - # Cool (15-20°C)
 - # Palatable
 - # +/- sports drink
 - # Regular ingestion
 - # 150-300mL every 15-20minutes
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Exercise 1 – 3 hours

- # As per 30-60 minutes
 - # 30-60g CHO/hour
 - # CHO-rich solids and gels +/- water
 - # 500-700mg sodium/L sports drink
 - # Combinations of sucrose, glucose, fructose and maltodextrins
 - # Fructose should not predominate
 - # Practise fluid delivery during training
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Exercise > 3 hours

- # As per 1-3 hours exercise
 - # Sports drink must contain CHO and sodium
 - # Flavour variety
 - # Higher CHO intake
 - # Caution: hyponatraemia
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Summary

Fluid Management

Determine:

- # Environment
 - # Exercise intensity
 - # Type of fluid
 - # Volume of fluid
 - # Frequency and timing of fluid
 - # Mode of fluid delivery
 - # Hydration state
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