Mount CAMEROON

EFFECTS OF BODY MASS INDEX (BMI), CARDIAC OUTPUT (CO) AND HAEMOGLOBIN QUOTIENT (HQ) ON THE PERFORMANCE OF MOUNT CAMEROON RACE ATHLETES

PLAN
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3. Body Mass Index
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INTRODUCTION
• Mountain is an extreme environment
• Effect of hypoxemia on athletes’ metabolism and performance
Well fitted physiological adjustments are determining for athletes performances.
How do the BMI, Q and HQ affect athletes’ performances in the Mt Cameroon race?

THE MOUNT CAMEROON RACE
• Every February, since 1973
• Shows Changing climatic zones
• Harder than standard mountain races
• Limiting factors for athletes
• Possible health outcomes (AMS / HACO)

How do BMI, Q and HQ affect endurance trained athletes’ performances in exercising under poor oxygen conditions?

BODY MASS INDEX
• It is important to assess body composition, especially in athletes
• Common methods are BMI, BIA, ADP and DXA
• BMI correspond to the weight divided by the square of the height, in Kg/m²
• Physiological meaning of BMI are shown below
**BODY MASS INDEX**

<table>
<thead>
<tr>
<th>Category</th>
<th>BMI range – kg/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emaciated</td>
<td>less than 18.5</td>
</tr>
<tr>
<td>Severely underweight</td>
<td>18.5 to 24.9</td>
</tr>
<tr>
<td>Underweight</td>
<td>25.0 to 29.9</td>
</tr>
<tr>
<td>Normal</td>
<td>30.0 to 34.9</td>
</tr>
<tr>
<td>Obese Class I</td>
<td>35.0 to 39.9</td>
</tr>
<tr>
<td>Obese Class II</td>
<td>40.0 to 44.9</td>
</tr>
<tr>
<td>Obese Class III</td>
<td>over 40</td>
</tr>
</tbody>
</table>

- A high BMI corresponds to a high body fat mass
- Fats are very important in endurance athletes metabolism
- There is reduced use of fat in mountain exercise
- High BMI and thus body fat mass is disadvantageous in mountain competition

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**Cardiac Output**

- **Cardiac Output** = Stroke Volume x Heart Rate
- Many factors influence Q:
  - Atrial kick
  - Preload
  - Afterload
  - Frank-Starling’s Law
  - Catecholamine stimulation
  - Coronary ischemia

- The increase in Q is due to increased heart rate due to sympathetic activity and increased catecholamine release
- The full mechanism on the chart below

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**Cardiac Output**

- Q is intimately related to energy production
- Muscular activity is energy consuming
- Sufficient Q is necessary to deliver adequate supplies of oxygen and nutrients (glucose) to the tissues.
- Low Q will reduce energy levels and subsequently athletic performances

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**Cardiac Output**

- Q is adjusted in acute exposure to altitude
- Coronal ischemia
### Cardiac Output

Q decreases in chronic exposure to altitude
- There is a drop in stroke volume
- There is reduction of plasma volume, due to:
  - Chemoreceptors stimulation
  - Increased release of atrial natriuretic peptide
  - Decreased synthesis of aldosterone
- There is also parasympathetic activity

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### HAEMOGLOBIN QUOTIENT

- Haemoglobin is the red pigment that carries oxygen in the blood
- Haemoglobin quotient correspond to mean corpuscular haemoglobin concentration (MCHC)
- It is the quotient of haemoglobin and haematocrit, in g.dl-1
- It is commonly referred at as the "haemoglobin concentration"

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### HAEMOGLOBIN QUOTIENT

- Oxygen is very important for energy production in endurance athletes
- In case of hypoxia, only an enhanced oxygen fixation and transport in blood can compensate the low PaO2
- High haemoglobin quotient
  - Improves lung diffusing capacity
  - Enhances systemic oxygen delivery

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### HAEMOGLOBIN QUOTIENT

- Up to 12% of athletes in this race are sickle cell trait carriers.
- This can seem threatening
- Researches on SCT carriers show that their reaction under exercise is similar to that of normal individuals

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### HAEMOGLOBIN QUOTIENT

- Low HQ in altitude competition results in lower performances
- High HQ enhances endurance capacity, proportional to oxygen carrying capacity
- Indirect assessment through lactate response confirms these observations

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### HAEMOGLOBIN QUOTIENT

- High haemoglobin concentration in altitude competition would cause
  - Good oxygen supply to the brain
  - Good leg blood flow
  - Good supply of exercising muscles
  - Higher degree of aerobic metabolism
  - Slow lactate production
  - Rapid lactate clearance in muscles
  - Slow lactate accumulation in muscles
  - Longer and better performance for athletes
HAEMOGLOBIN QUOTIENT

• An increase in haemoglobin and haematocrit has been observed with acclimatisation to altitude
• The acute stage (<1 week) is due to plasma depletion
• The chronic stage is due to increased release of EPO

SUMMARY

• Mount Cameroon race is one of the most strenuous competitions in the world
• High HQ, high HR and a low BMI within the normal range, are advantageous for the athlete
• Serious endurance training and acclimatisation to the mountain environment should be done before engaging in the competition

THANK YOU