

# Redox biology, exercise physiology, and sports nutrition: creative synergies and ideas for research projects

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# Existential crisis

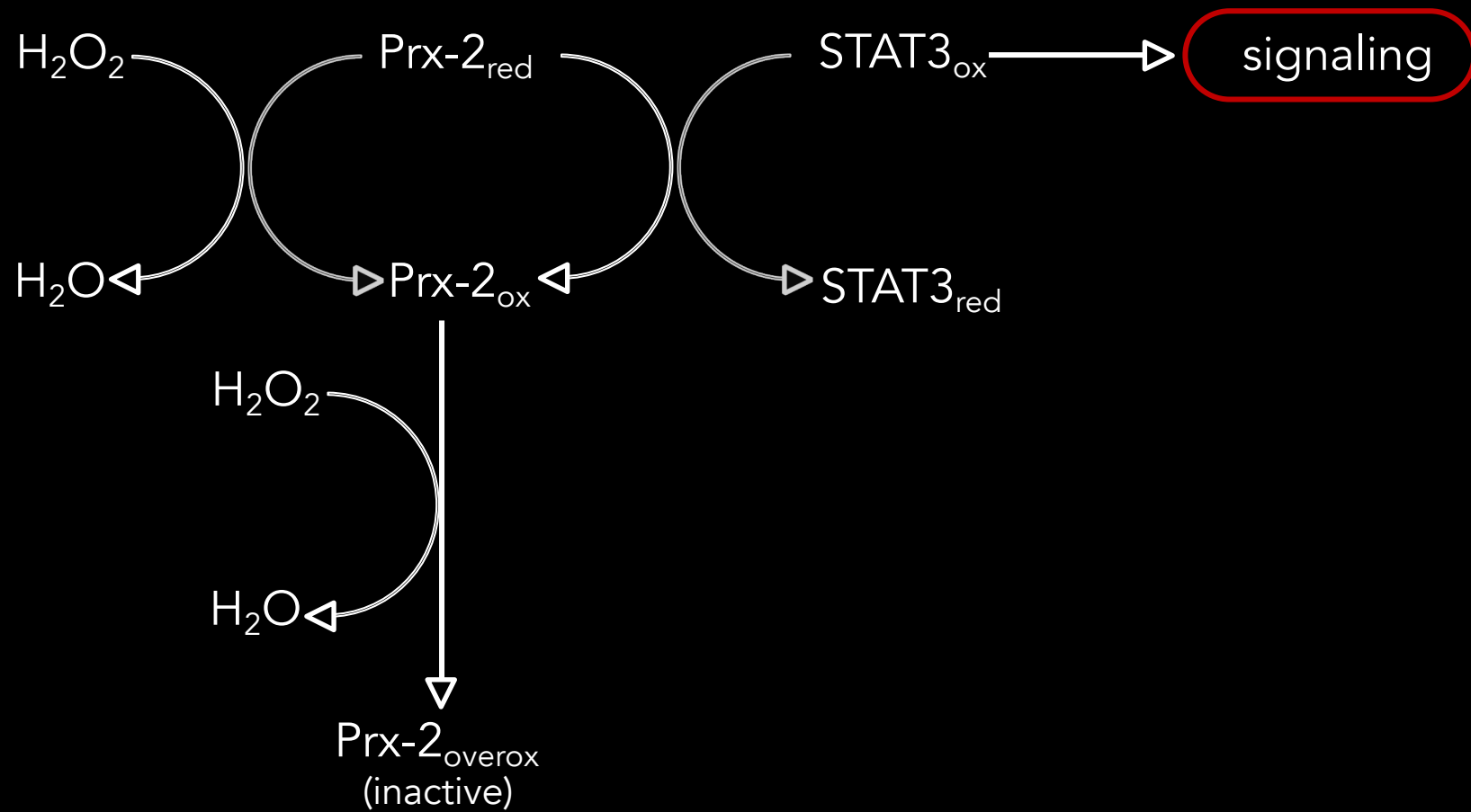
How to move from feasible chemical reactions to feasible physiological effects



Redox (bio)chemistry

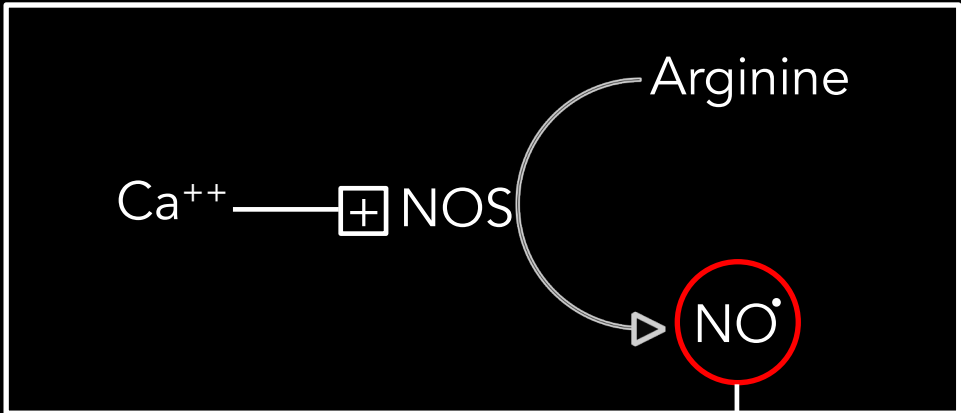
Exercise physiology  
Sports Nutrition

# Redox signaling

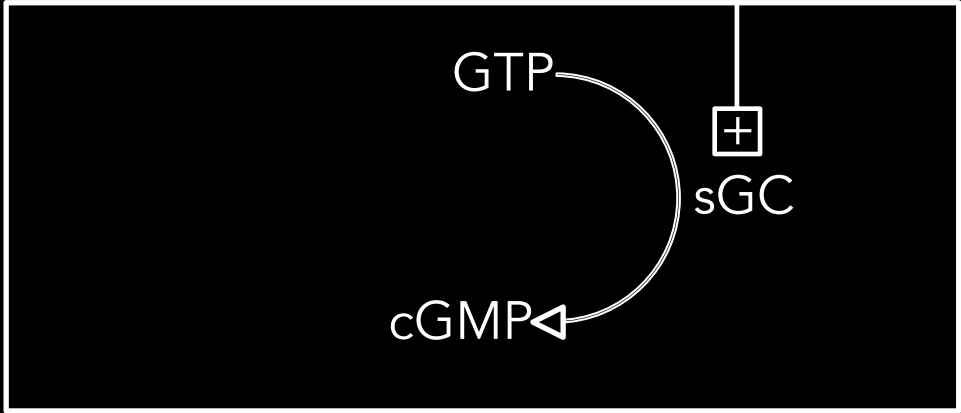


# Vasodilation

Endothelium



Smooth muscle



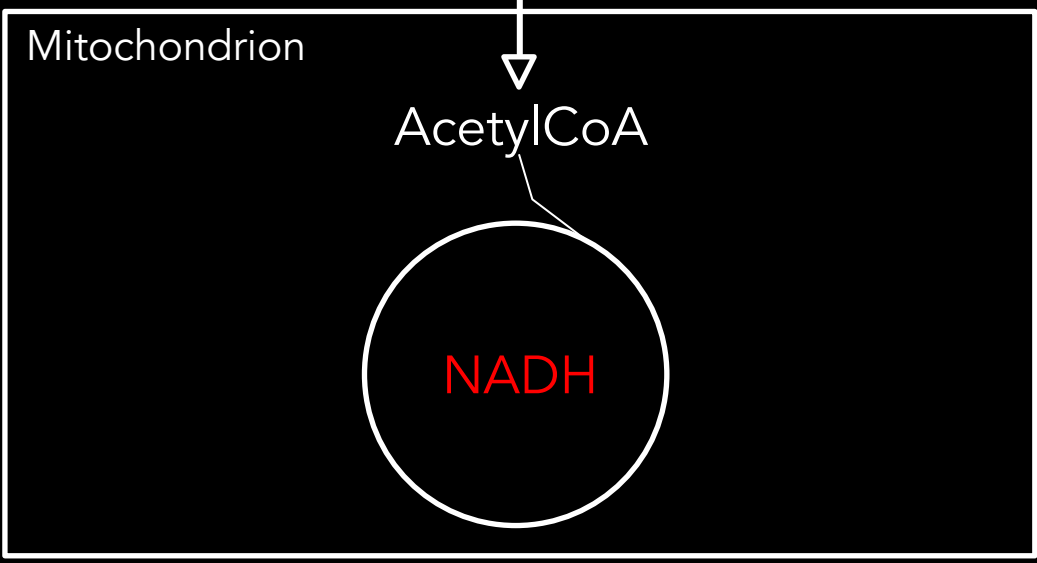
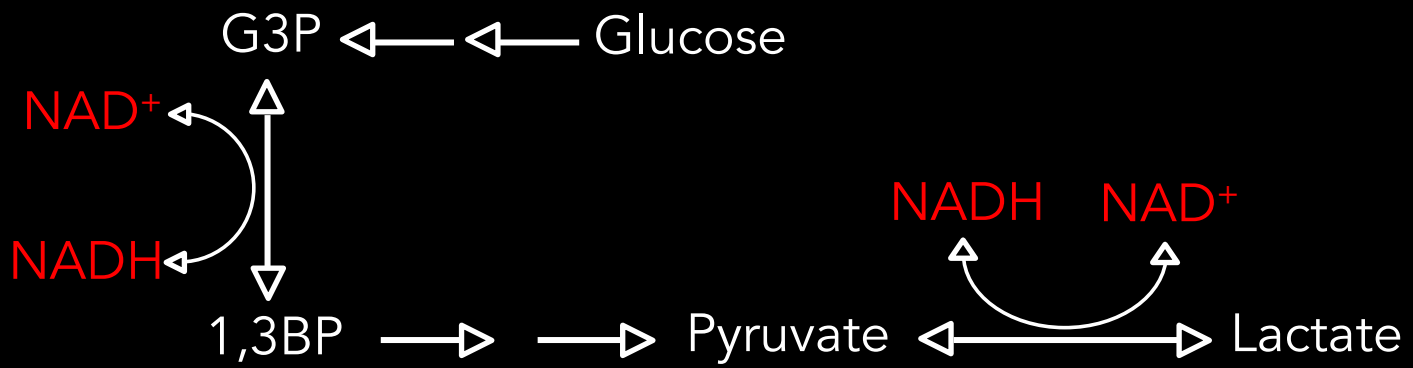
# Phagocytosis

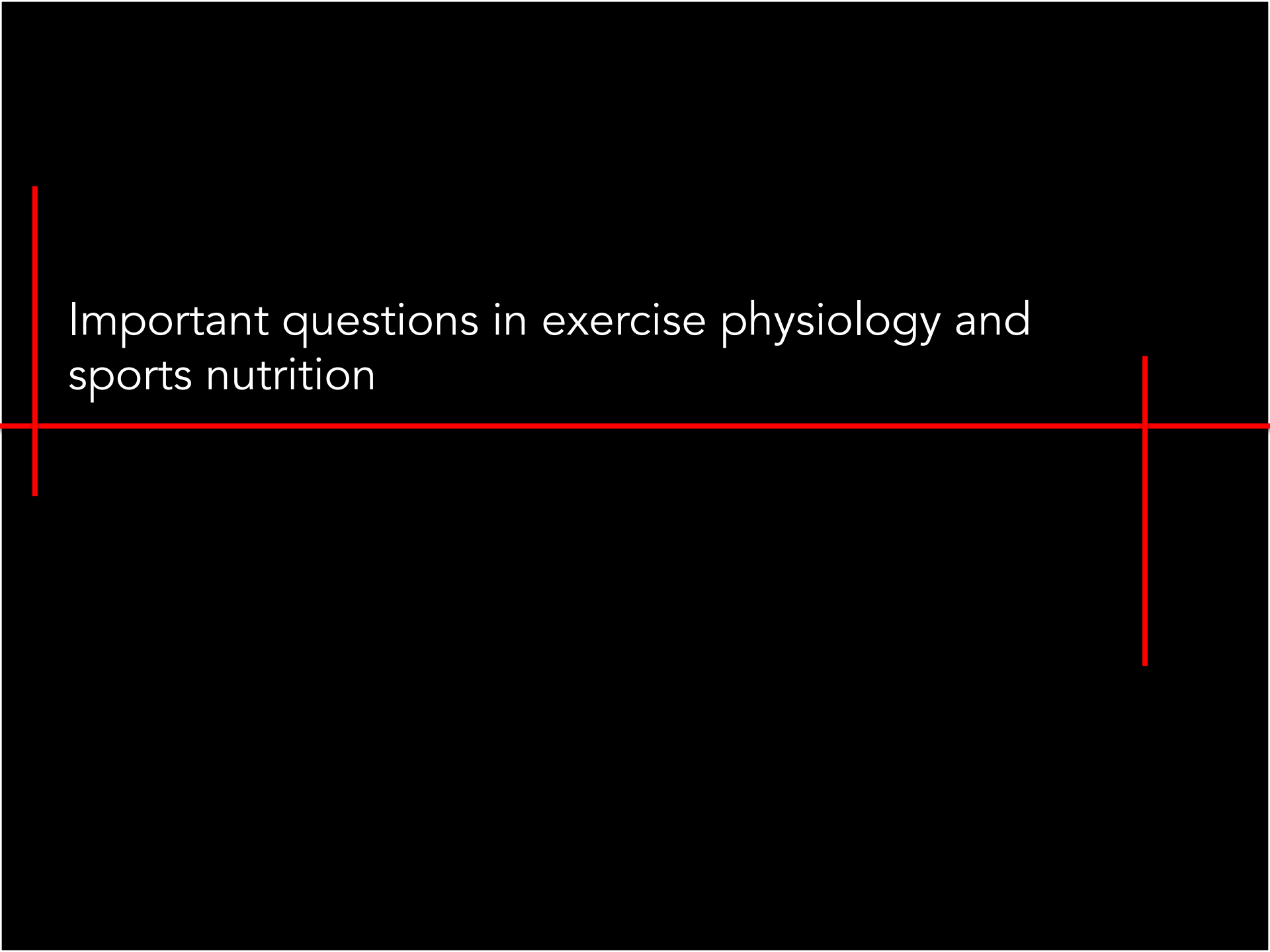
Neutrophil



# Energy metabolism

Cytoplasm





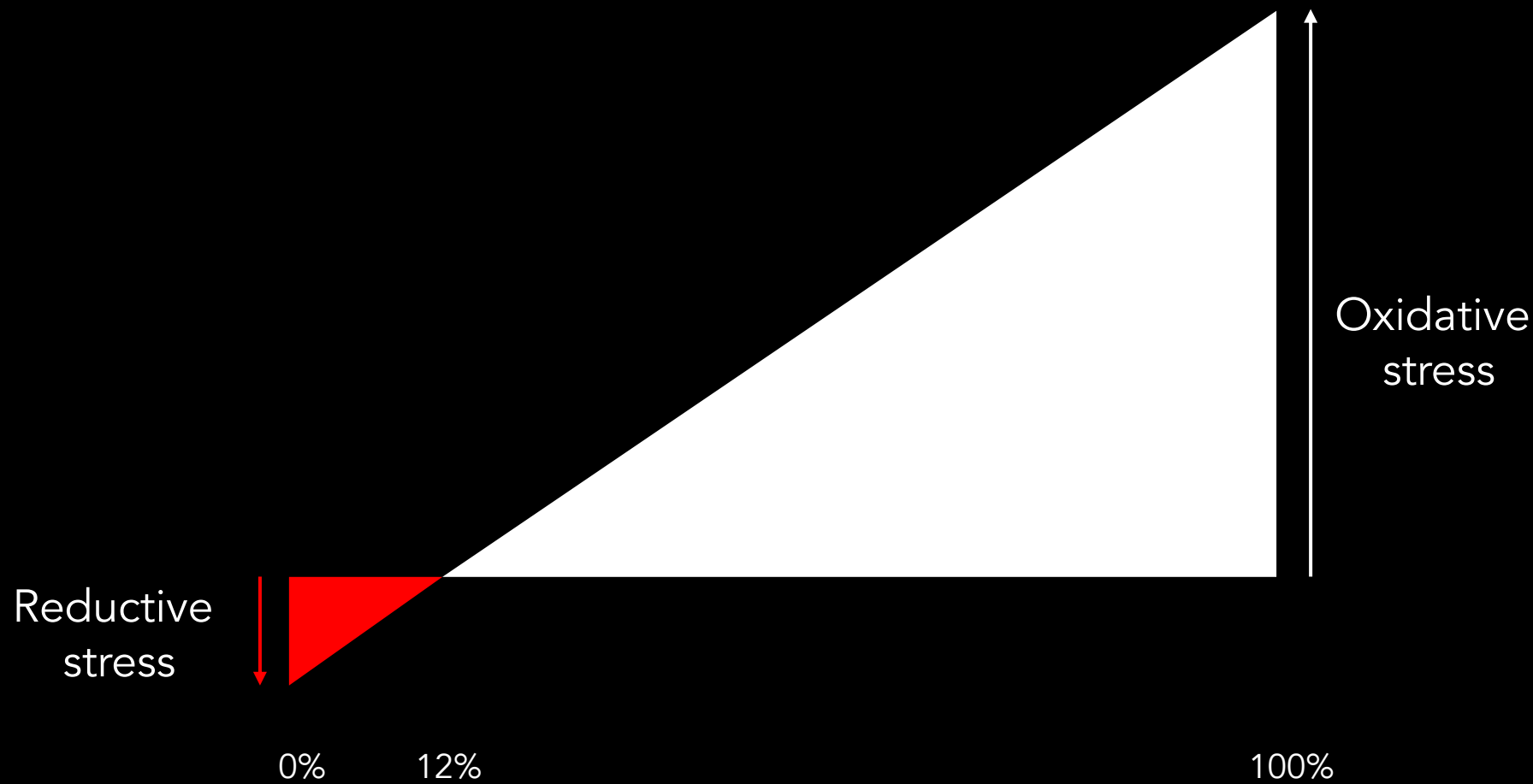
Important questions in exercise physiology and  
sports nutrition



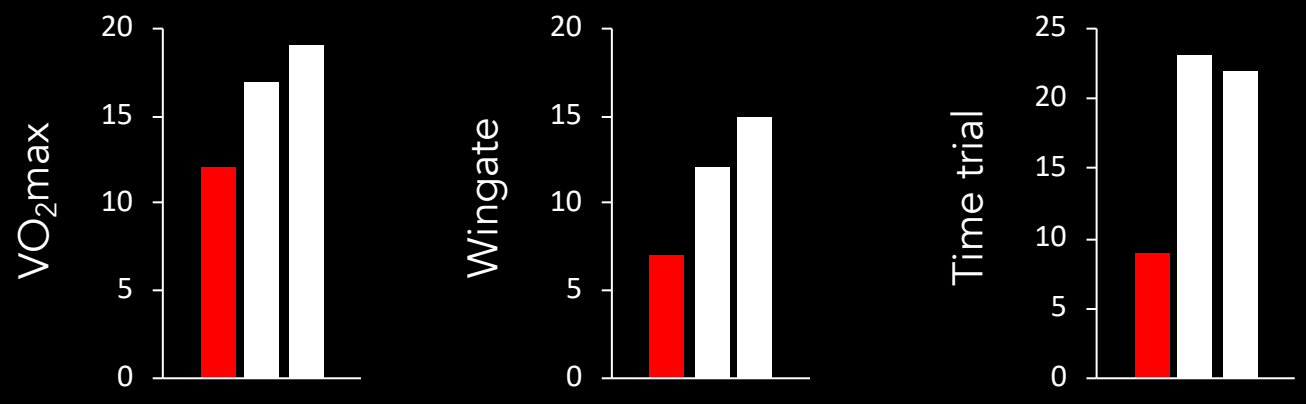
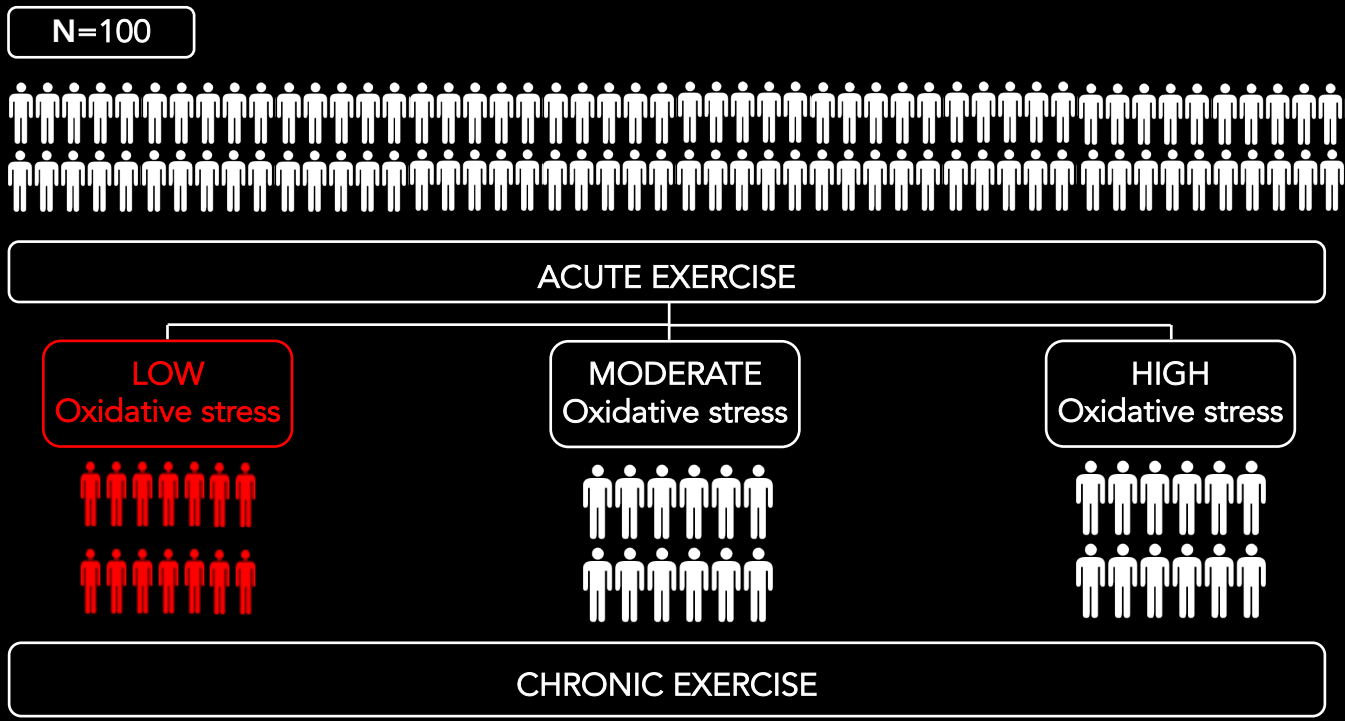
## Question 1

Does exercise-induced free radicals control adaptations?

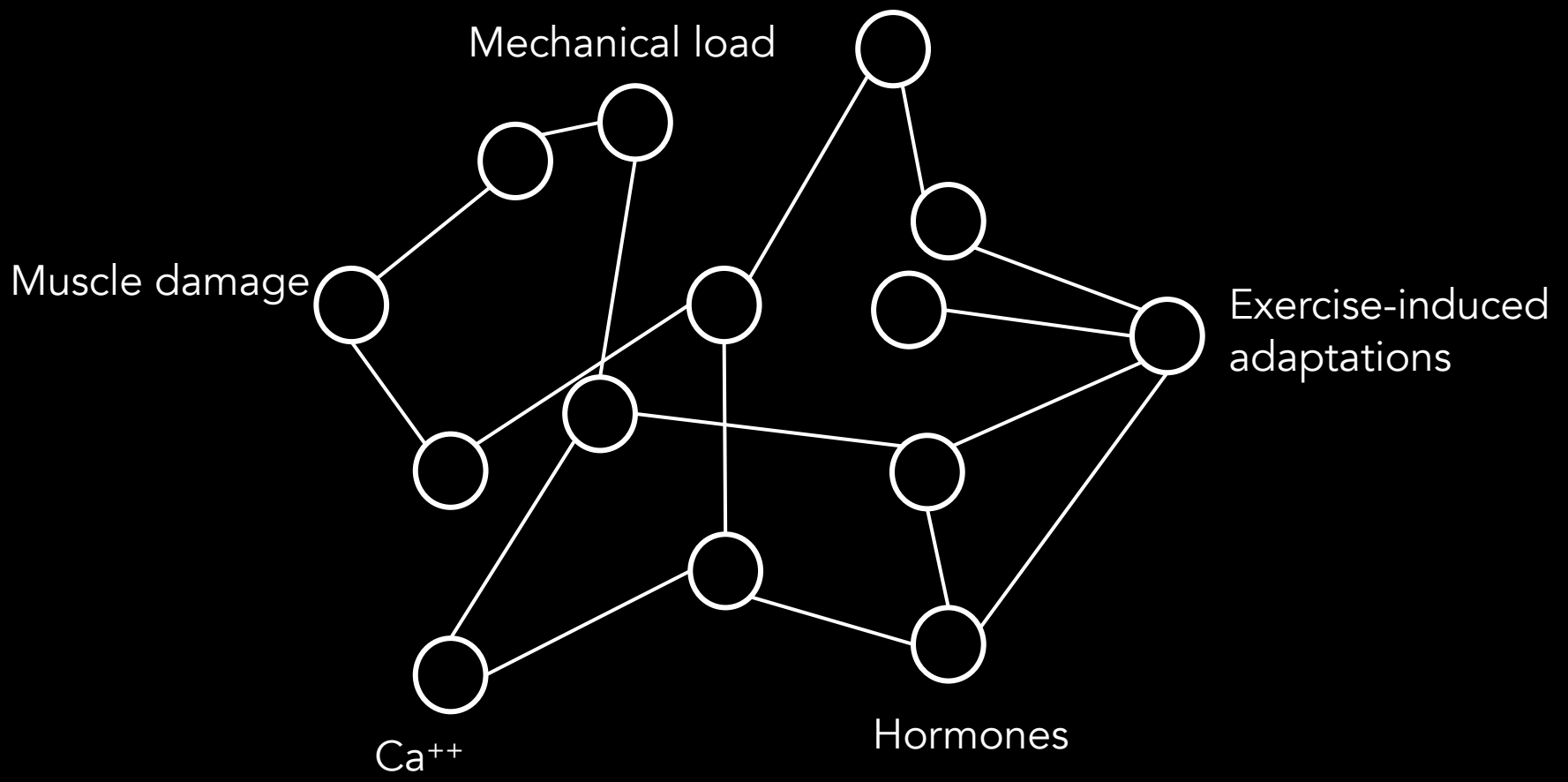
# Harnessing redox individuality



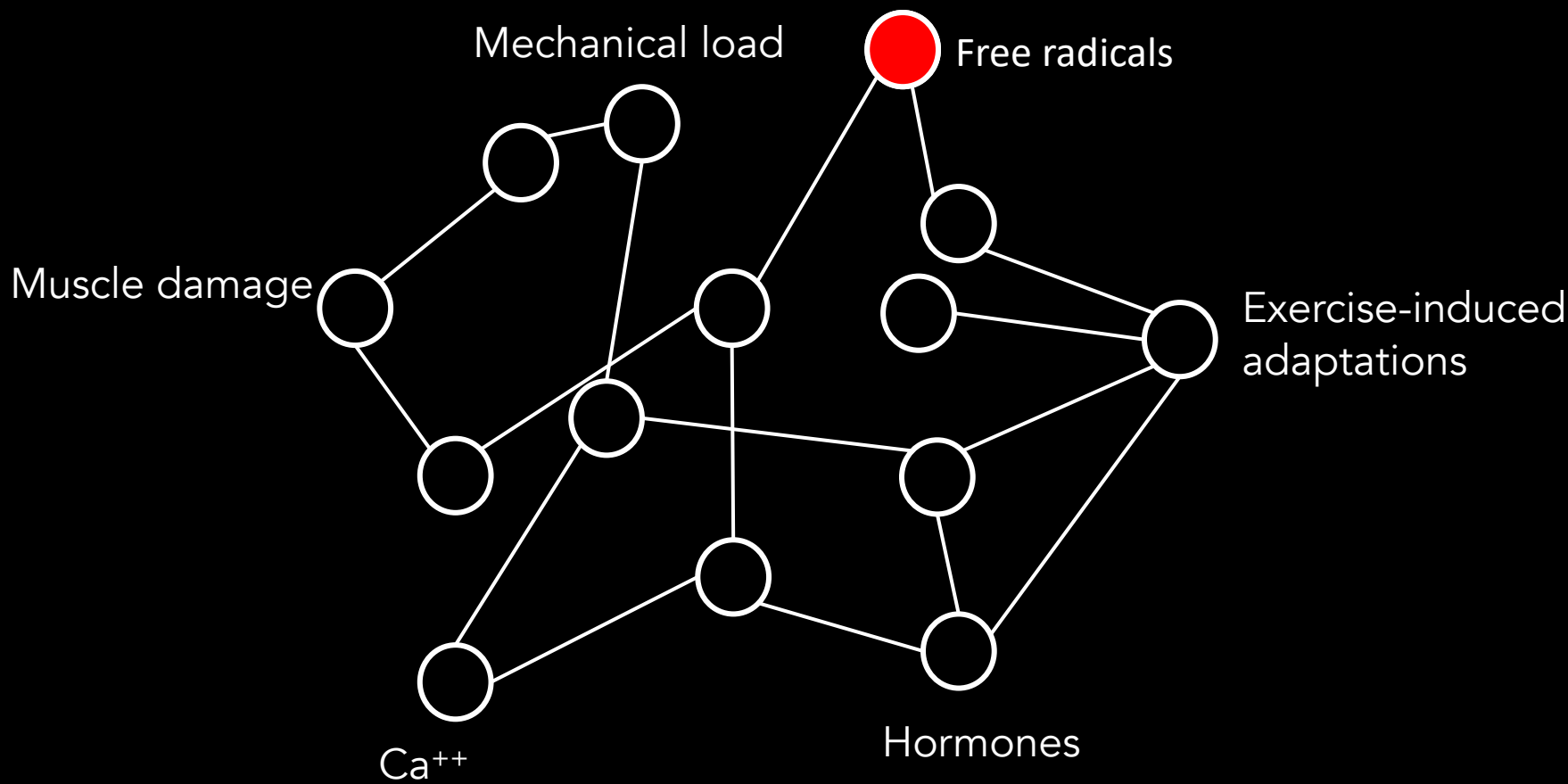
# Oxidative stress promotes exercise adaptations



# Exercise signals



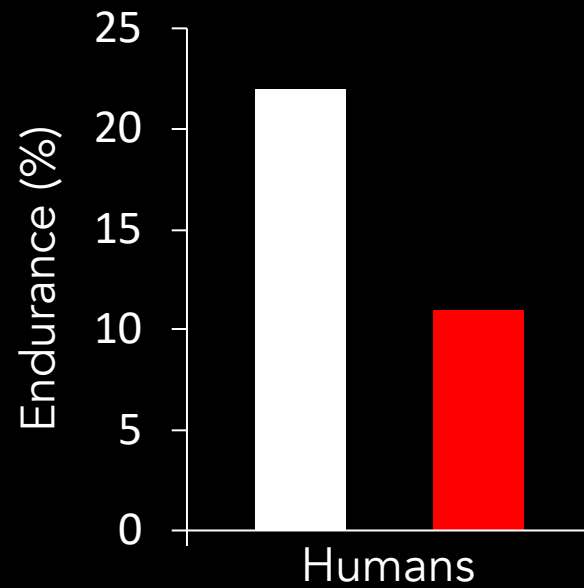
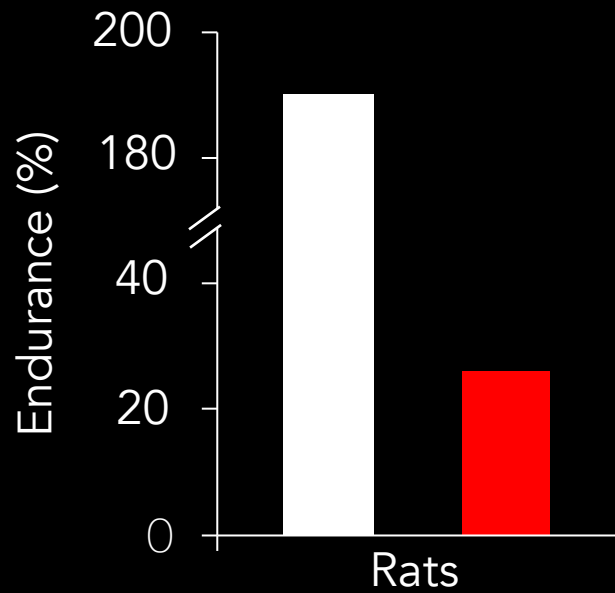
# Redox biology feeds exercise physiology



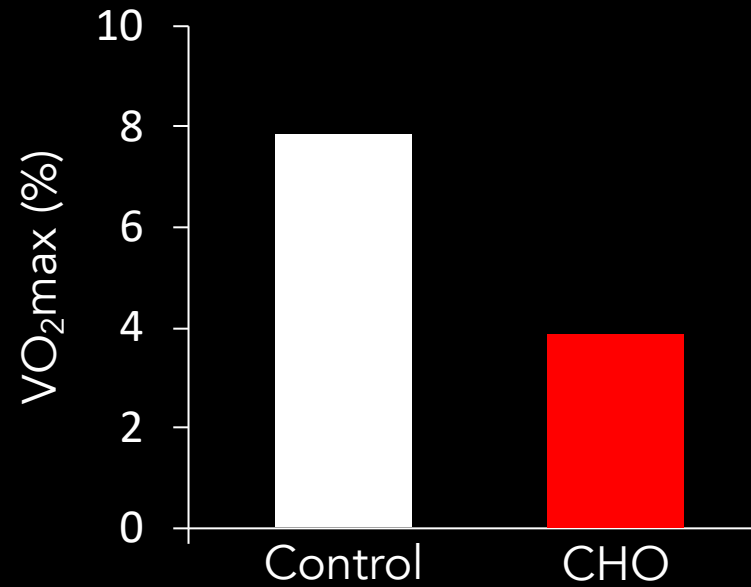
## Question 2

Does antioxidant supplementation impair adaptations?

# Antioxidants impair training adaptations



# Carbohydrates might impair training adaptations too...





Sports Med (2018) 48:1031–1048  
<https://doi.org/10.1007/s40279-018-0867-7>



CURRENT OPINION

## **Fuel for the Work Required: A Theoretical Framework for Carbohydrate Periodization and the Glycogen Threshold Hypothesis**

**Samuel G. Impey<sup>1</sup> · Mark A. Hearnis<sup>1</sup> · Kelly M. Hammond<sup>1</sup> · Jonathan D. Bartlett<sup>2</sup> · Julien Louis<sup>1</sup> · Graeme L. Close<sup>1</sup> · James P. Morton<sup>1</sup>**



Positive

Neutral



Positive

Neutral

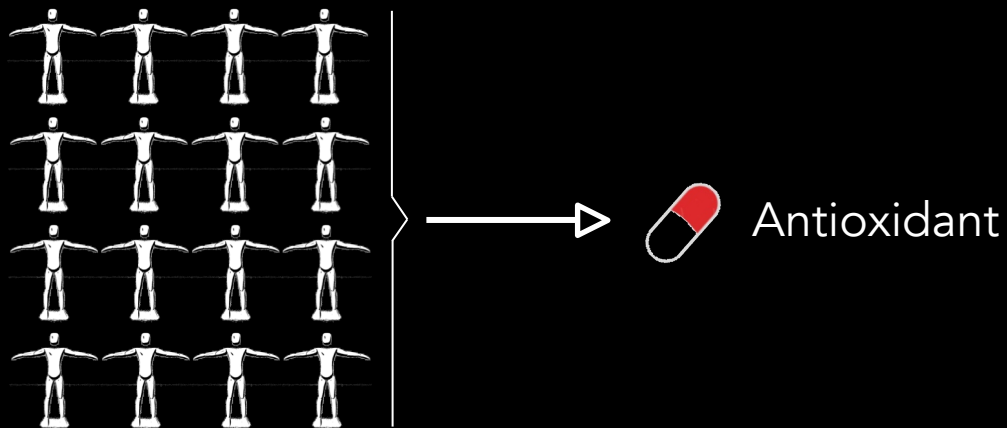
Negative

## Question 3

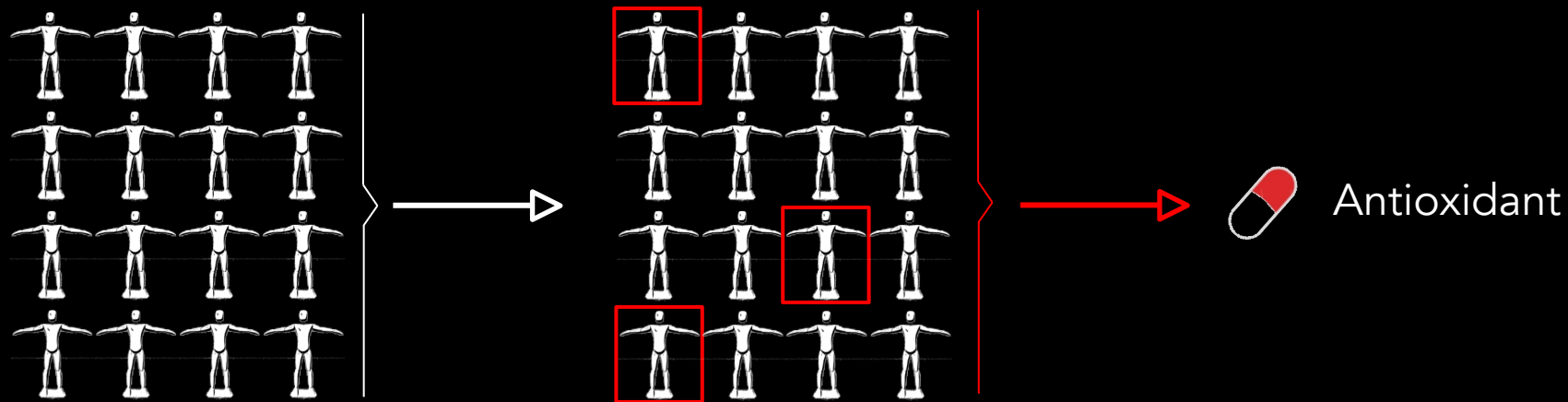
Any positive effects of antioxidant supplementation?

# Personalised approach

## Conventional

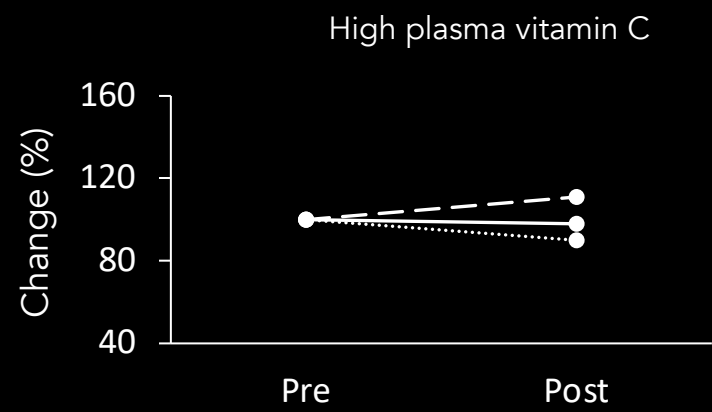
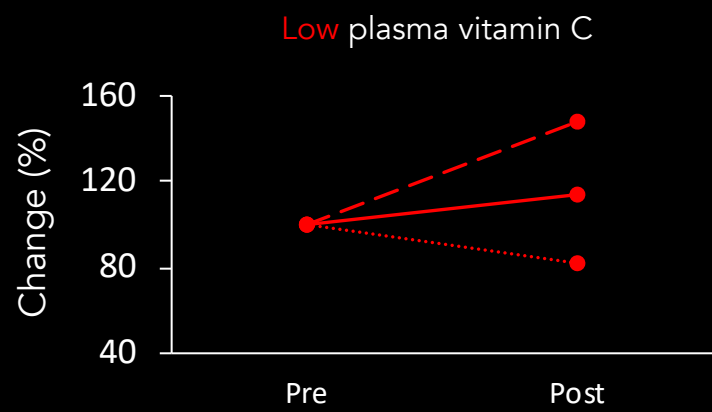


## Stratification

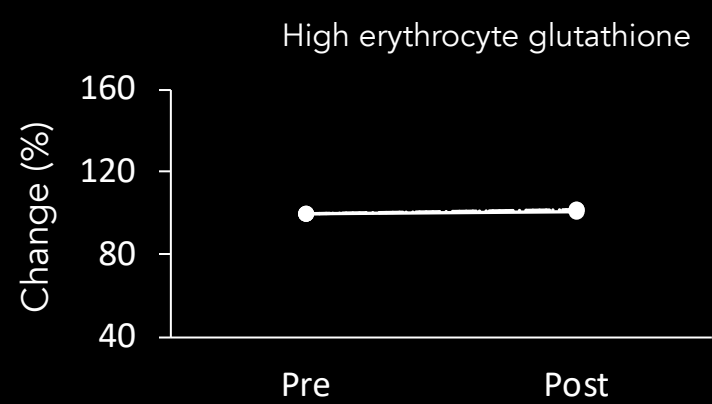
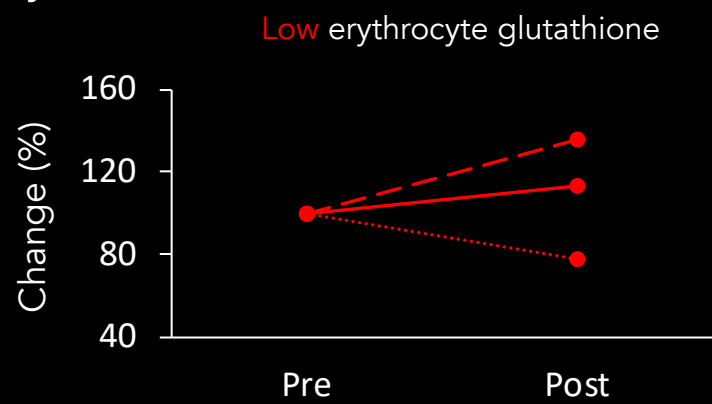


# Positive effects in deficient individuals

## Vitamin C

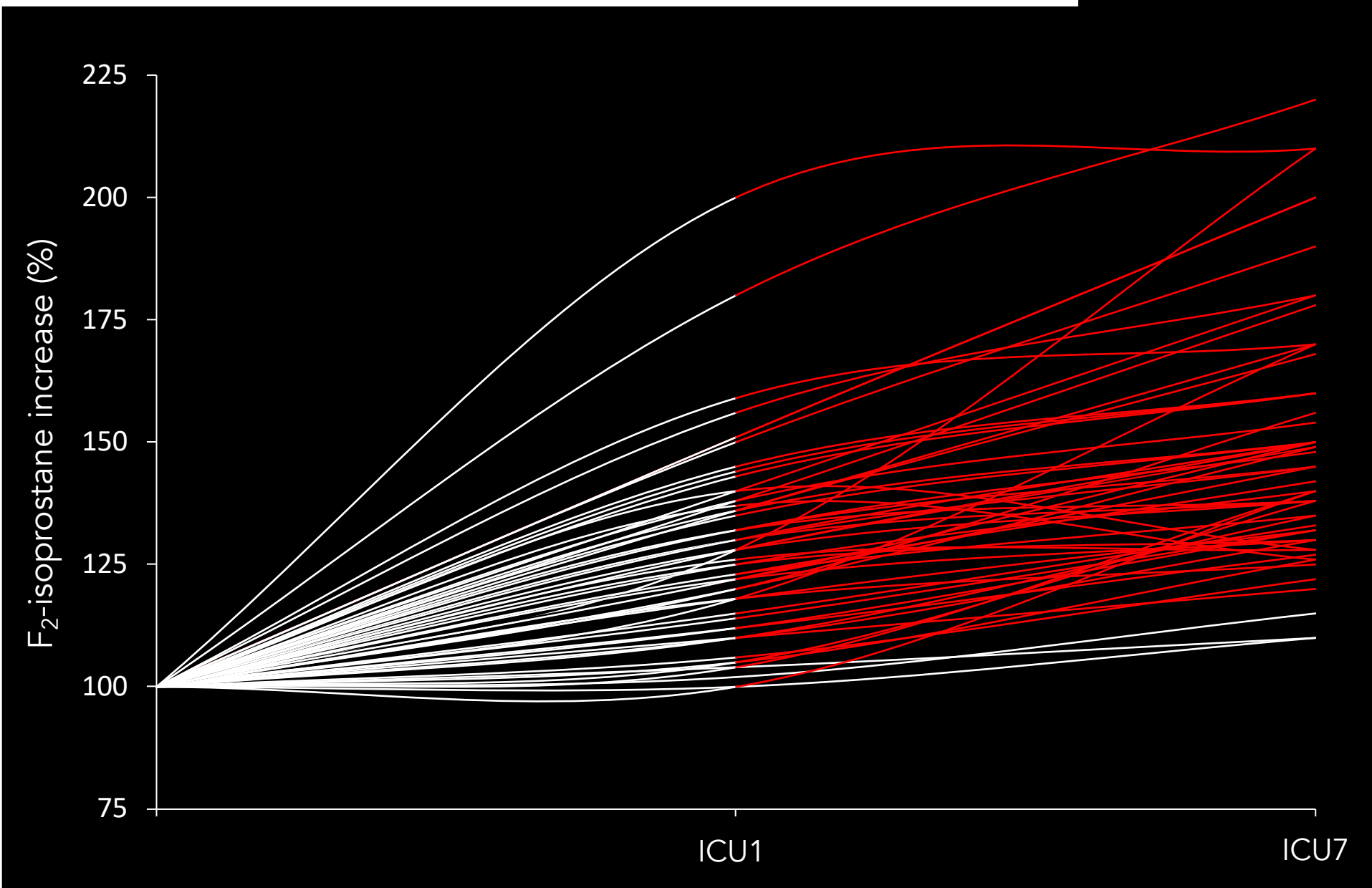


## N-acetylcysteine

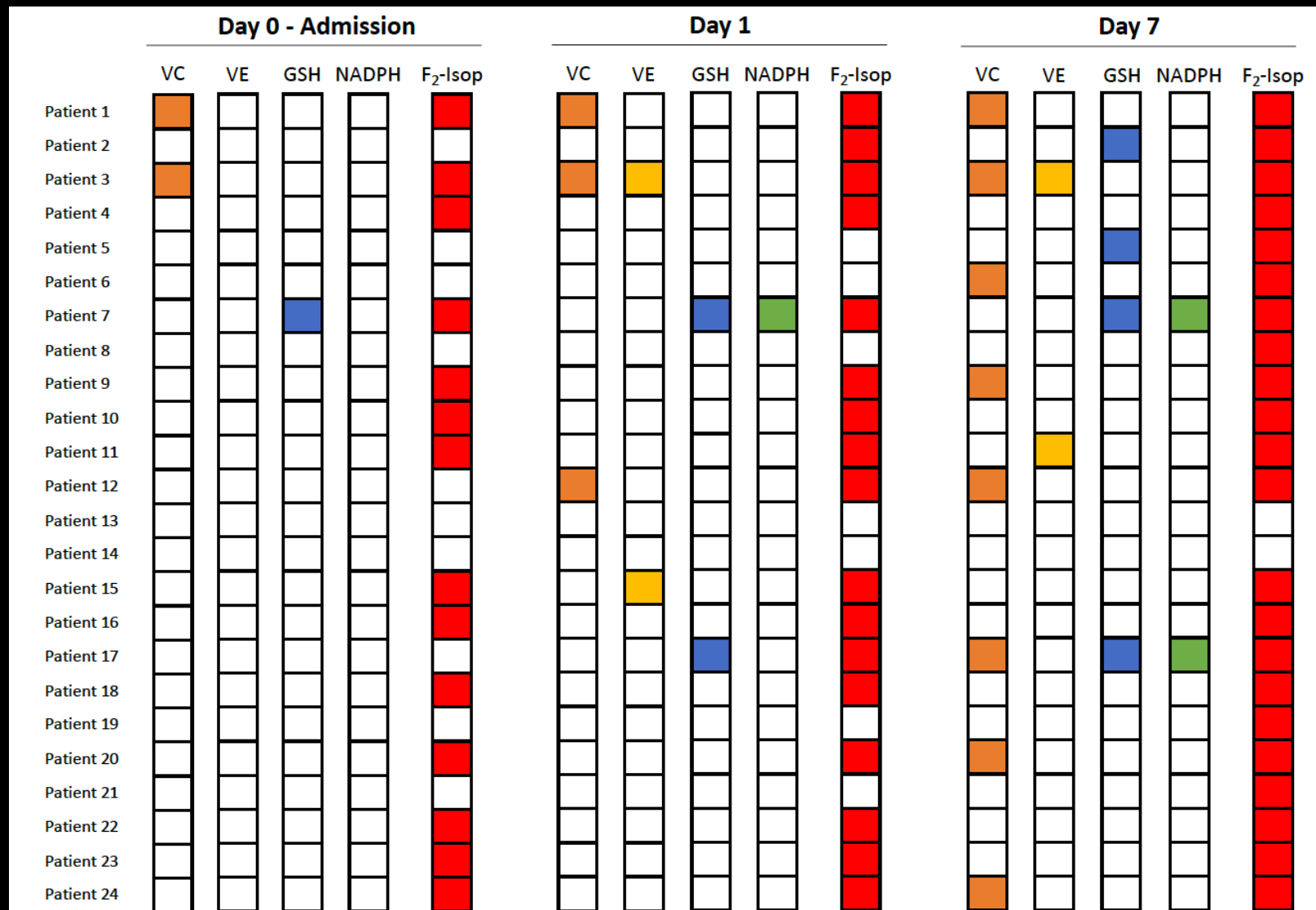


— Performance    - - - Antioxidant    ..... Oxidative stress

# Oxidative stress in the Intensive Care Unit (ICU)



# Personalised deficiencies in the ICU patients



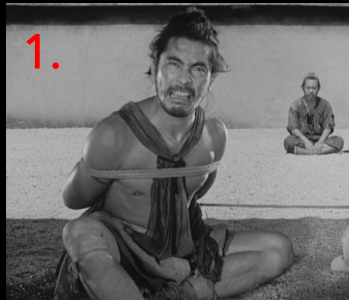




Some methodological limitations and suggestions

# The Rashomon effect in biology and nutrition

Different physiological conclusions based on the same redox evidence



Conclusions from the same results depend only on the different premises about oxidative stress

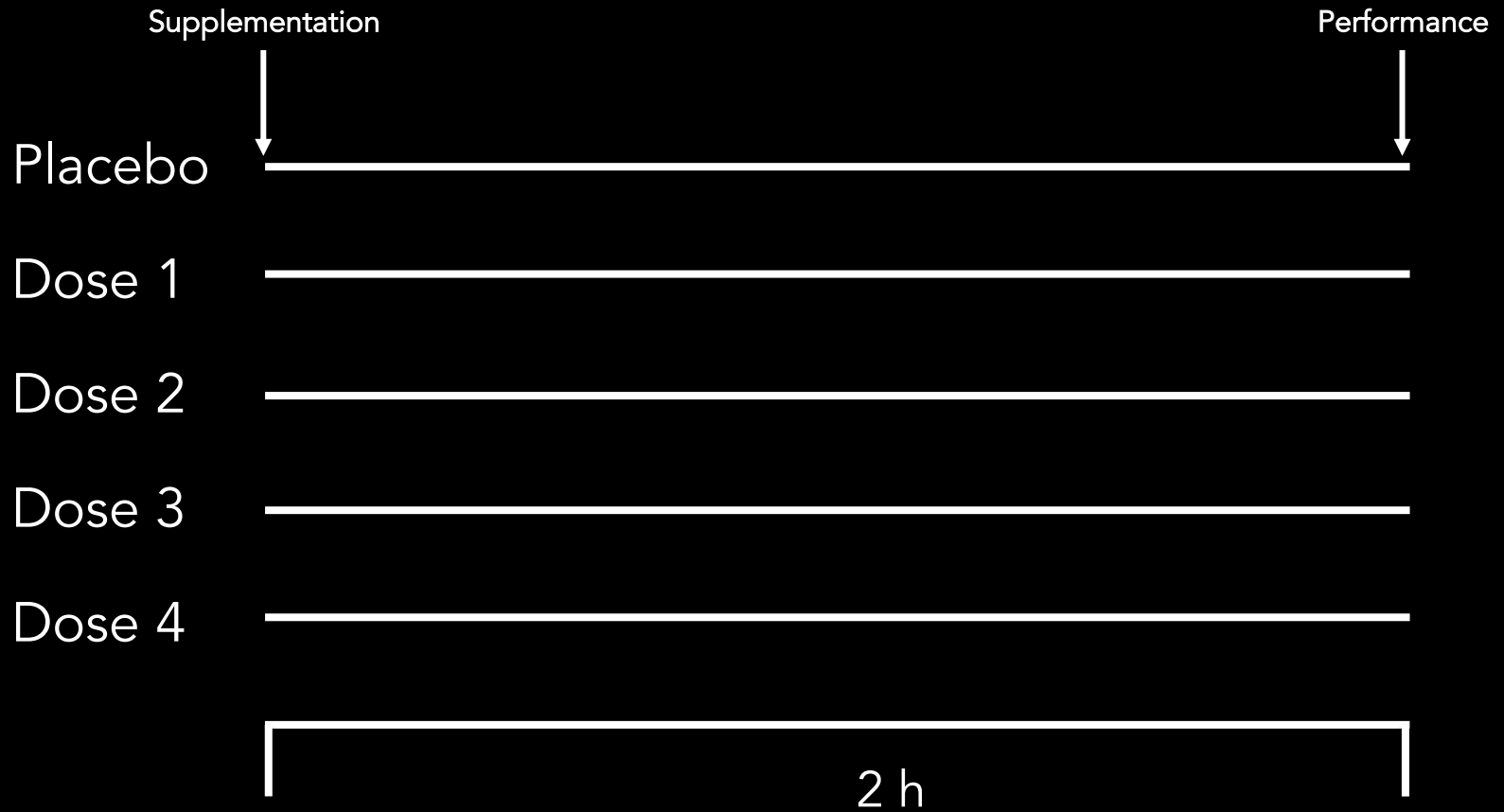
|                   |   |
|-------------------|---|
| <b>Scenario A</b> | Oxidative stress is "BAD"                                     |
| Fact              | Exercise induces oxidative stress                             |
| Premise           | Exercise-induced oxidative stress <u>impairs</u> adaptations  |
| Result            | An antioxidant suppresses exercise-induced oxidative stress   |
| Conclusion        | The antioxidant <u>promotes</u> adaptations                   |
| <b>Scenario B</b> | Oxidative stress is "GOOD"                                    |
| Fact              | Exercise induces oxidative stress                             |
| Premise           | Exercise-induced oxidative stress <u>promotes</u> adaptations |
| Result            | An antioxidant suppresses exercise-induced oxidative stress   |
| Conclusion        | The antioxidant <u>impairs</u> adaptations                    |

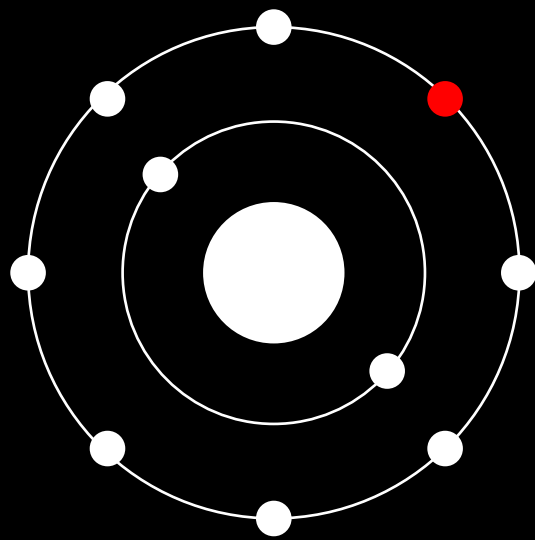
# Towards more realistic representations in exercise physiology and sports nutrition

1. Make as few assumptions as possible about the physiological information contained in molecular measurements
2. Accompany every redox measurement with clearly translatable physiological measurements
3. Accept that a study can have loose ends

Hormesis theory:  
a "victim" of the Rashomon effect and an idea  
for a future experiment

# The first experiment to test the hormesis theory...





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