Effect of Acute Nitrate-Containing Beverage Consumption on Oxygen Consumption Efficiency in Adults

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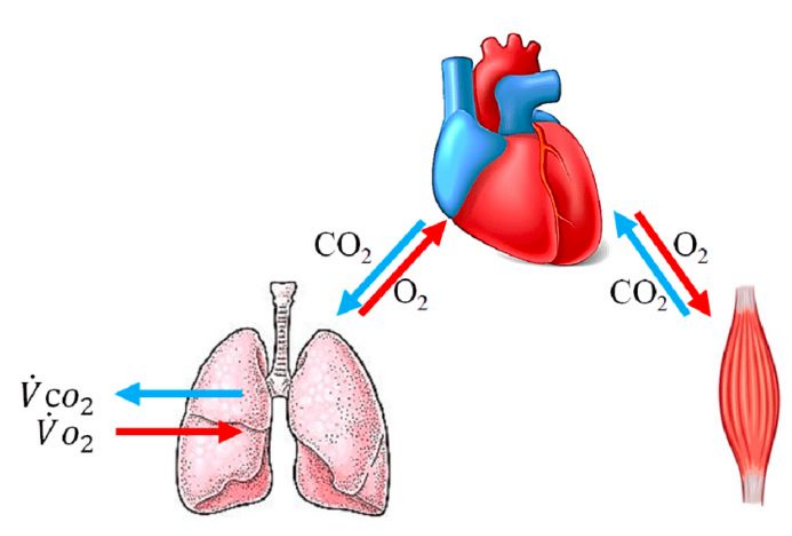
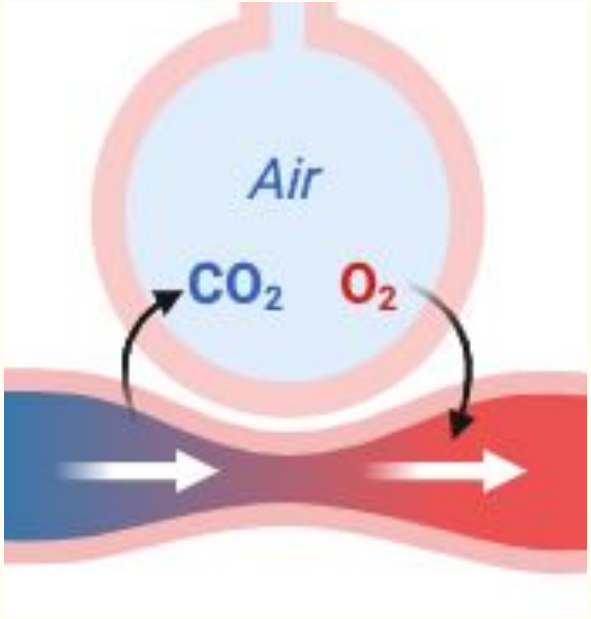
Background

Oxygen Consumption (VO_2)





Oxygen consumption: amount of oxygen used in ATP synthesis

Oxygen consumption efficiency (OCE): ratio of oxygen consumed to ATP produced

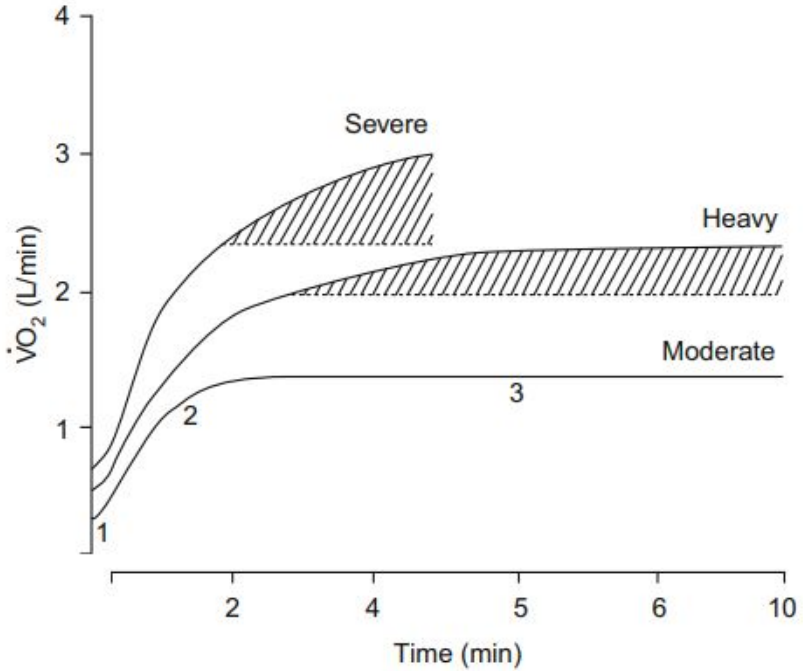


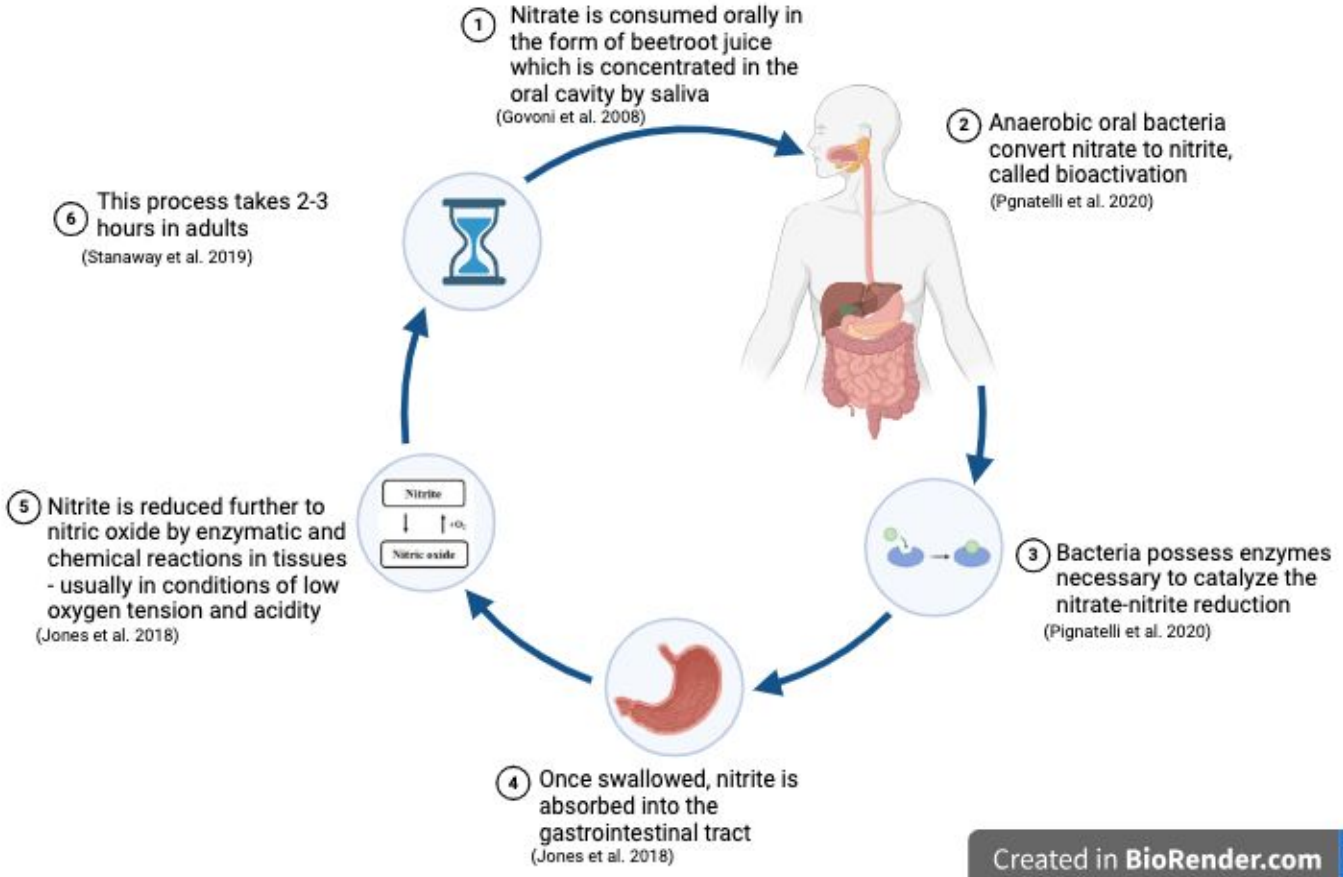
Fig. 1. Schematic of the $\dot{V}O_2$ responses to constant-load exercises at different intensities. The numbers of 1, 2 and 3 indicate the 3 phases of $\dot{V}O_2$ responses. The shaded areas represent the slow component of $\dot{V}O_2$, which is above that predicted from subthreshold $\dot{V}O_2$ work rate relationship (adapted from Gaesser and Poole,[4] with permission).

(Xu and Rhodes 2012)

Steady State

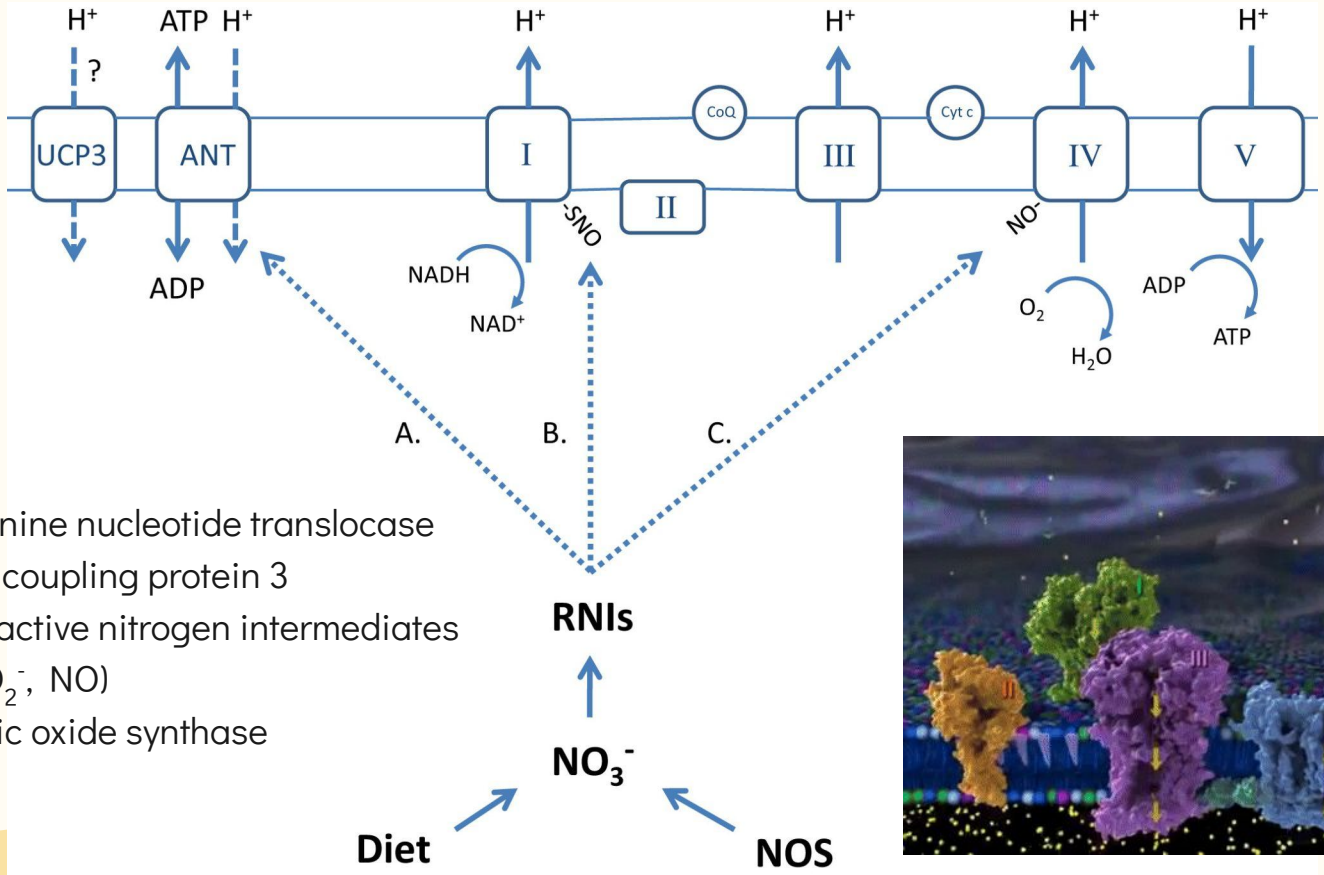
- **Steady state:** physiological equilibrium between energy demand and aerobic metabolism.
- $\dot{V}O_2$ increases exponentially to a steady-state level

Nitrate-Nitrite-Nitric Oxide Pathway (Jones et al. 2018)



Nitrate Pathway

Nitrate effect on mitochondria



ANT: Adenine nucleotide translocase

UCP3: Uncoupling protein 3

RNIs: Reactive nitrogen intermediates (NO_2^-, NO)

NOS: nitric oxide synthase

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Material and Methods

Experimental parameters

Equipment

- Stationary bike (NEO Tacx Bike Smart)
- BRJ shot (Beet It Sport Nitrate 400 Concentrated Beet Juice)
- Chest-strap heart rate monitor (Polar H10)
- Spirometer pod
- Respiratory flow heads and tubes
- Gas analyzer
- Douglas bags
- Garmin, Tacx Training App
- Power Lab

Participants

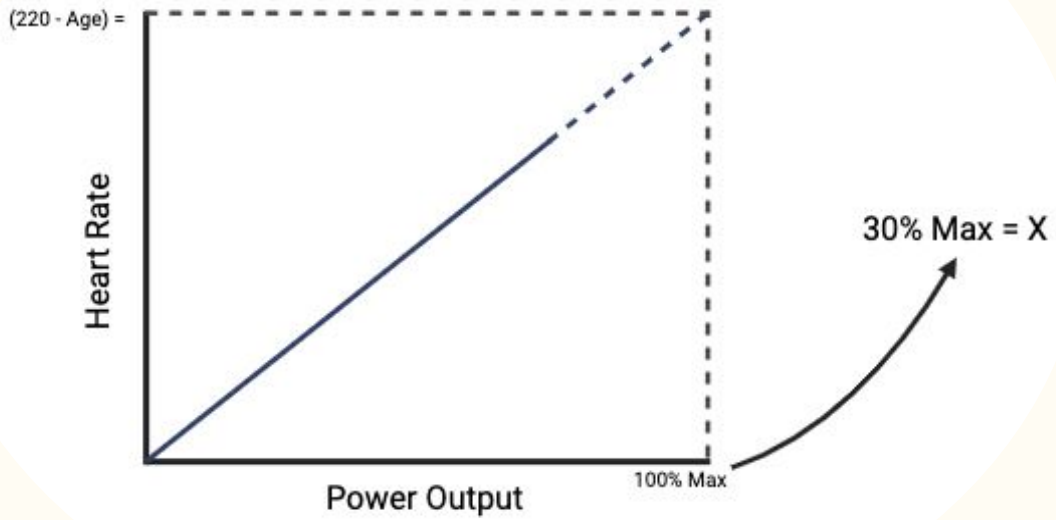
8 volunteers

4 males and 4 females

Aged 20 ± 2

Baseline Testing

- 2-minute 30W warm up
- 4W increases every 15 seconds
- Stop at a heart rate of 160 bpm
- Extrapolated max power output
- 15% and 30% was calculated



Factors Accounted For

A time gap of 2.5 hours between the consumption of beetroot juice or calorically equivalent juice and the control or experimental trial was used.

Control

70 calories worth of a calorically-equivalent juice.

Experiment

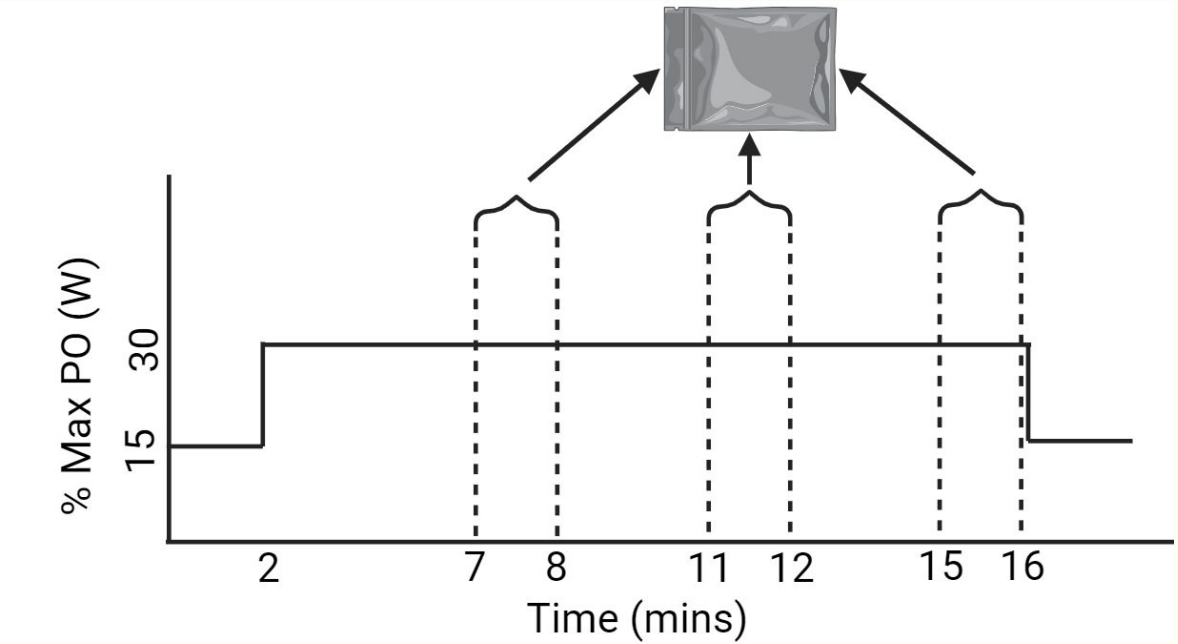
Beet-It Beetroot juice shot, 70 calories with 400mg of Nitrate

(Jones et al. 2018)

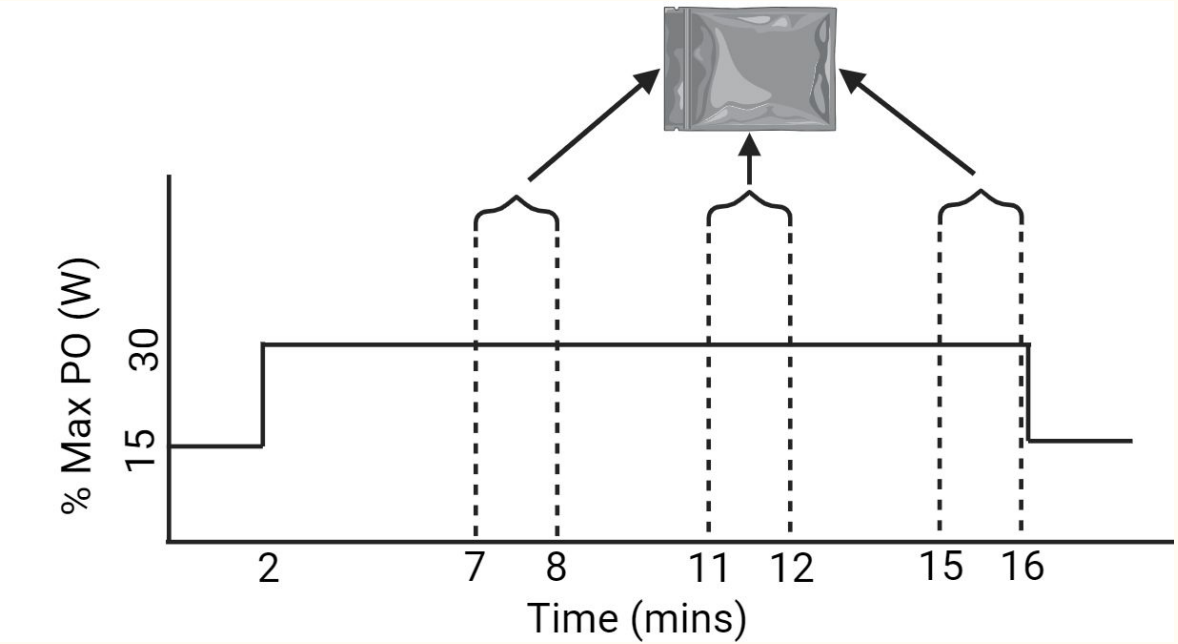
Experimental Design

- Refrain from consuming nitrate-rich foods for 24 hours prior
- Drink a provided juice 2.5 hours before the trials

Experimental Trial



Control Procedure



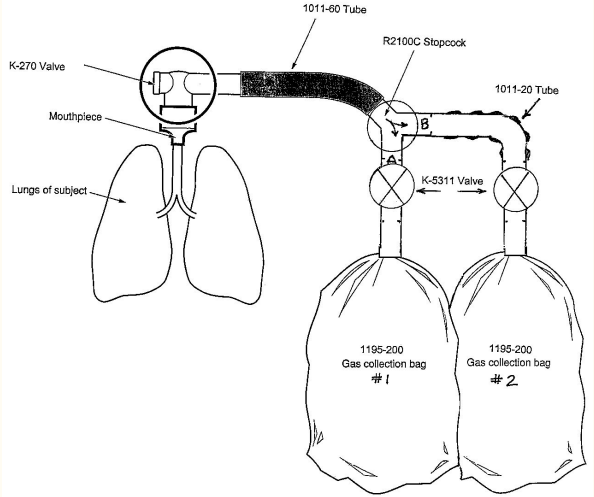
Sample Collection

- Douglas bags collect expired gas
- % O_2 and % CO_2 via gas analyzer
- Airflow of expelled air measured via spirometer pods
- Data collected on PowerLab
- HR recorded using Garmin Connect

$$\dot{V}O_2 = (\dot{V}_I \bullet F_IO_2) - (\dot{V}_E \bullet F_EO_2)$$

$$\dot{V}CO_2 = (\dot{V}_E \bullet F_ECO_2) - (\dot{V}_I \bullet F_ICO_2)$$

$$RER = \dot{V}CO_2 / \dot{V}O_2$$



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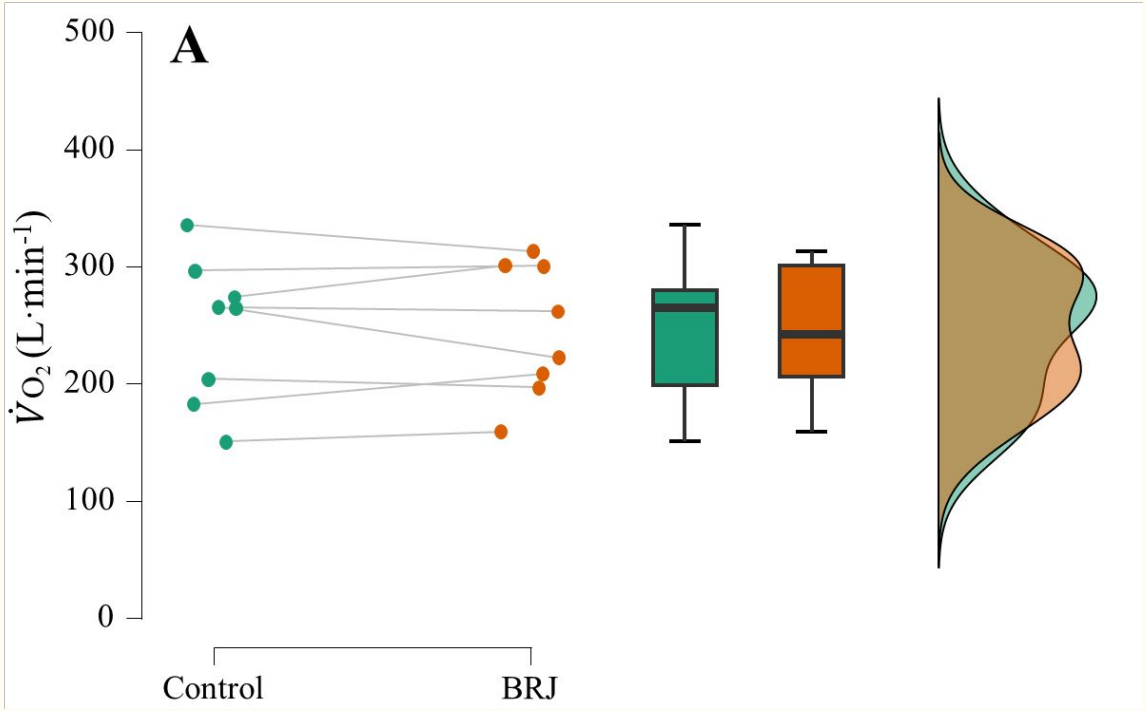
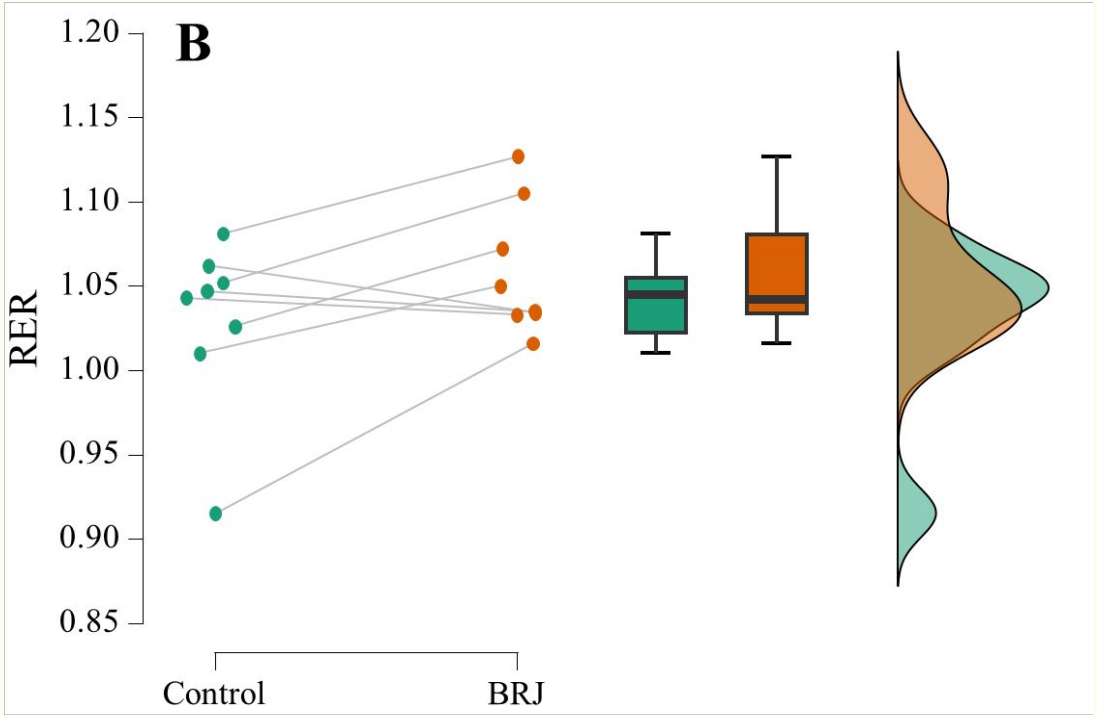
Results

Oxygen consumption (VO_2)



No significant difference (p=0.888)

Respiratory Exchange Ratio (RER)



No significant difference (p=0.093)

High RER (>1.00)

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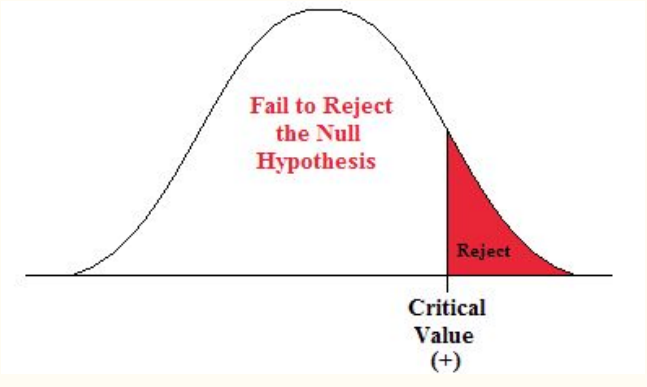
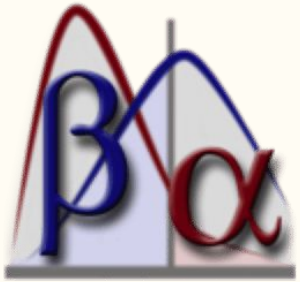
Discussion

Findings

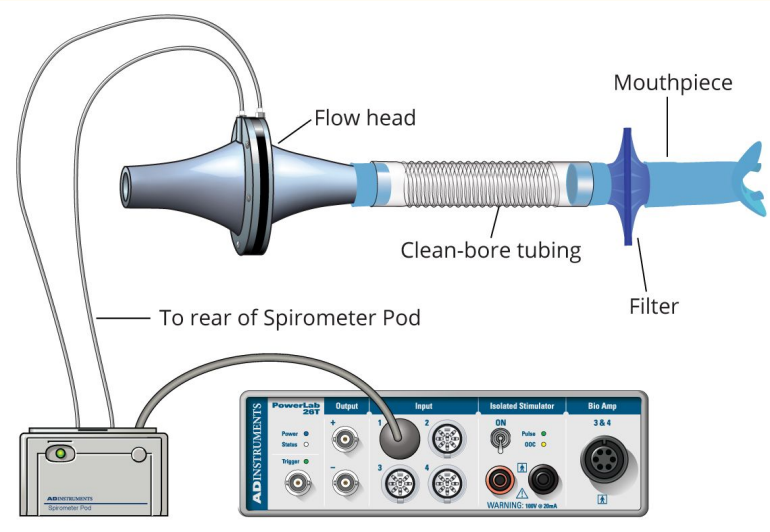
- No significant effect on OCE
- Is oral ingestion the right approach?
- Antiseptic mouthwash usage
- Statistical significance by G*Power
  - n=33 in RER
  - n=1056 in VO_2

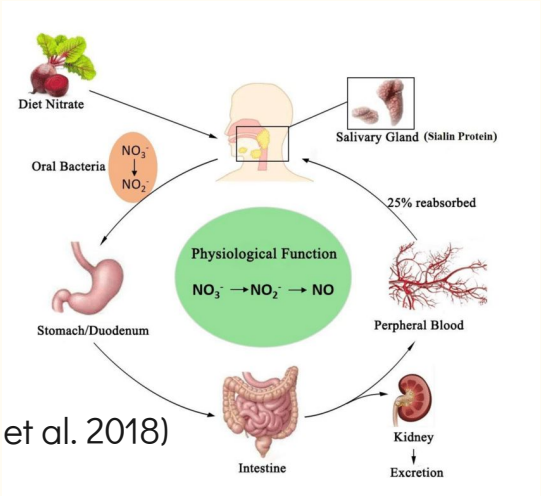




Sources of Error

- Hole in the spirometer pod hose
- Was all the nitrate absorbed?
- RPM variation when biking





(Ma et al. 2018)


Conclusion

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Thanks!

Do you have any questions?