



# The effect of carbohydrate mouth rinse on physical performance during a 24.5 km cycling time trial



Escuela Universitaria  
Real Madrid  
Universidad Europea

 Universidad  
Camilo José Cela



Gabriel Martins, PhD Student. <sup>1, 2</sup>

Juan Del Coso, PhD. <sup>2</sup>

<sup>1</sup> Real Madrid University, European University, Madrid

<sup>2</sup> Camilo José Cela University, Madrid



# Introduction

Fielding et al., 1985  
Coyle et al. 1986

CHO feeding during exercise improves performance >2h



Carter et al. 2004a

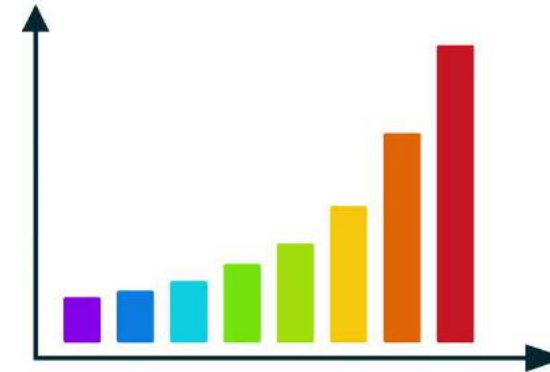
CHO blood infusion failed to improve 40km cycling performance



Carter et al. 2004b

CHO mouth rinse improved 2.1% performance on the same cycling trial

First CHO mouth rinse study



1967

Bergstrom et al., 1967

1997

2004

2004

2012

...

2017



Shorter bouts of high intensity exercise <1h at >75% of maximum oxygen uptake can be improved by CHO

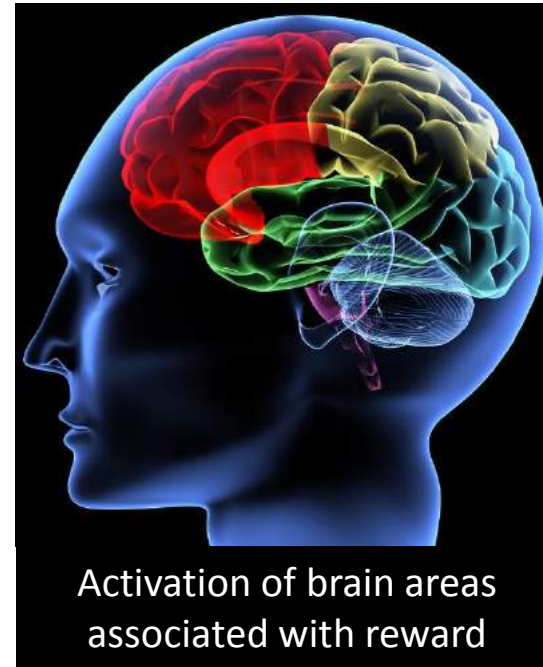
Jeukendrup et al. 2004a



A continuous body of evidence has been growing until recently

- Drink concentrations
- Rinse duration
- Fed or fasted state
- CHO type
- Endurance or power-based sports

# Theoretical mechanism



Caffeine?  
Quinine?  
Menthol?  
Acetic acid?

Activation of brain areas associated with reward





Generation of motor output

Performance enhancement

Decreased RPE

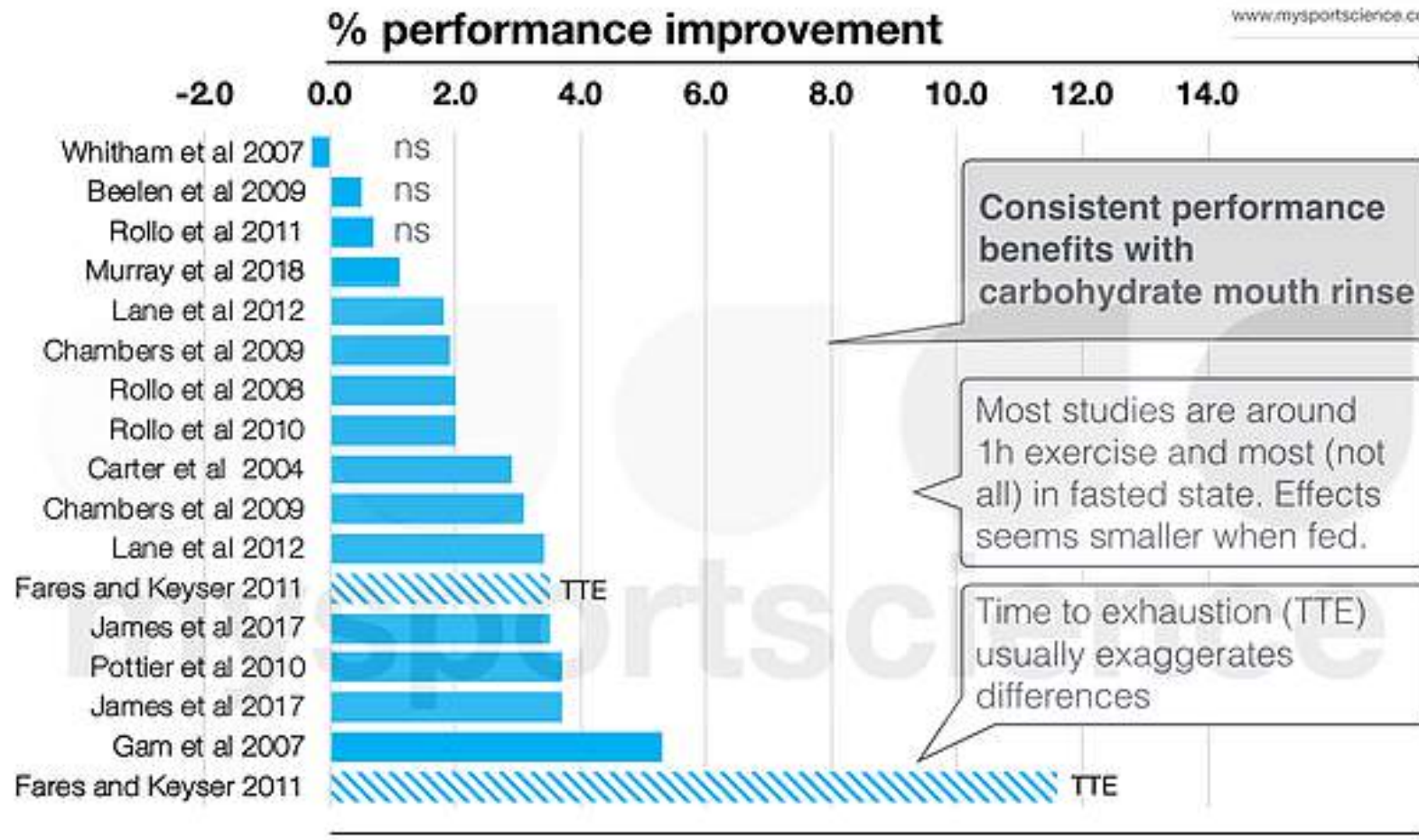
Decrease the negative signals from fatigued muscles and alter fatigue perception and motor output

No changes in **blood glucose** or **plasma insulin**

|   | <b>Authors</b>        | <b>n</b> | <b>Trial type</b>              | <b>CHO</b>          | <b>Fed/fasted</b> | <b>Rinse duration</b> | <b>Effect</b> |
|---|-----------------------|----------|--------------------------------|---------------------|-------------------|-----------------------|---------------|
|    | Carter et al., 2004b  | 9        | 60min TT                       | 6.4% Maltodextrin   | 4h                | 5 sec                 | ↑             |
|    | Whitham et al., 2007  | 7        | 15` + 45` TT                   | 6% Maltodextrin     | 4h                | 5 sec                 | ↓             |
|    | Rollo et al., 2008    | 10       | 40min running                  | 6% GLU + MD mix     | >10h              | 5 sec                 | ↑             |
|    | Chambers et al., 2009 | 8        | ~60min TT                      | GLU + MD            | >10h              | 10 sec                | ↑             |
|    | Beelen et al., 2009   | 14       | ~68min TT                      | Maltodextrin        | 2h                | 5 sec                 | —             |
|    | Rollo et al., 2010    | 10       | 60h running                    | GLU+ MD             | 13-15h            | 5 sec                 | ↑             |
|    | Pottier et al., 2010  | 12       | ~60min TT                      | Sucrose             | 3h                | 5 sec                 | ↑             |
|    | Rollo et al., 2011    | 10       | 1h running                     | GLU                 | 3h                | 5 sec                 | —             |
|    | Fares et al., 2011    | 13       | 60% Wmax TTE                   | MD<br>MD            | Overnight<br>3h   | 5 to 10 sec           | ↑             |
|    | Lane et al., 2013     | 12       | 60min TT                       | 10% MD              | 9-10h<br>2h       | 10 sec                | ↑             |
|    | Gam et al., 2013      | 10       | ~67min TT                      | 6.4% MD<br>No rinse | 4h<br>4h          | 5 sec                 | ↑             |
|    | Sinclair et al., 2014 | 11       | 30` + 10km TT                  | MD 10s<br>MD 5s     | 4h                | 5 vs 10sec            | —             |
|   | Murray et al. 2018    | 8        | 40km TT                        | 6.4% GLU            | ~5h               | 10 sec                | ↑             |
|  | Decimoni et al., 2018 | 15       | Resistance Exercise<br>10 REPS | 6%                  | 8h                | 10sec                 | ↑             |



## Effects of carbohydrate mouth rinse on endurance performance



Source: [Mysportscience.com](http://Mysportscience.com)  
 Jeukendrup, 2018. With permission

- To study the **influence of a carbohydrate solution (CHO) on the performance** of a simulated cycling time trial.
- A CHO mouth rinse will **positively affect performance** and RPE) when compared to a placebo rinse (PLA).





## SUBJECTS

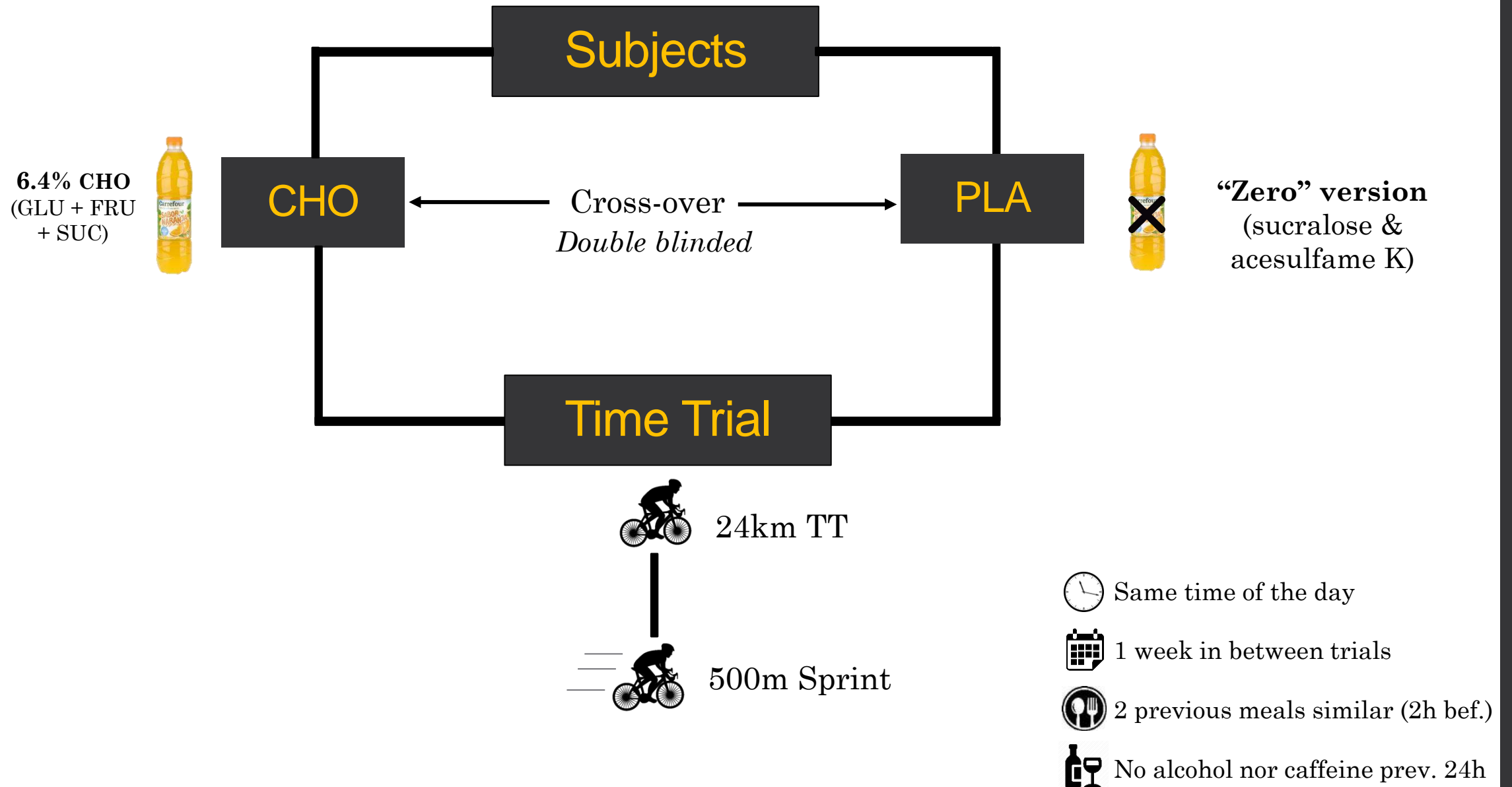
- $n = 20$
- Amateur, moderately trained
  - Age  $41.0 \pm 10.5$  y
  - Body mass  $76.9 \pm 7.9$  kg

## CONDITIONS

- Fed state (same meal at the same hour, both days)
- No exercise (previous 48h)
- No competitions (previous 7 days)

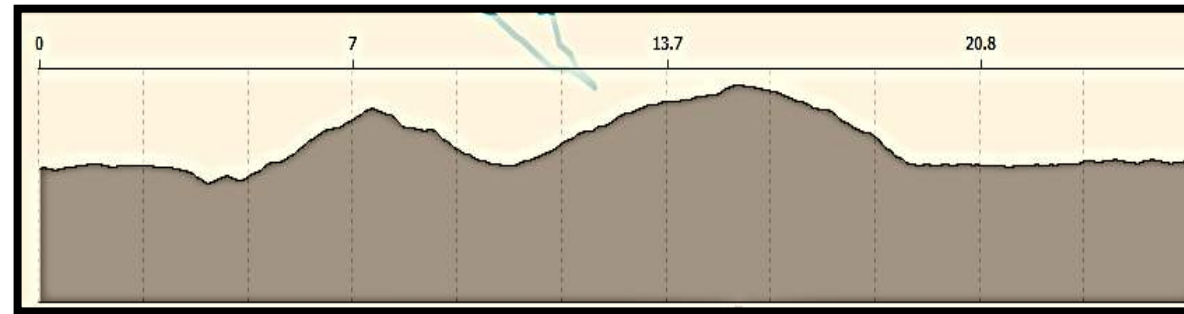


# Study design





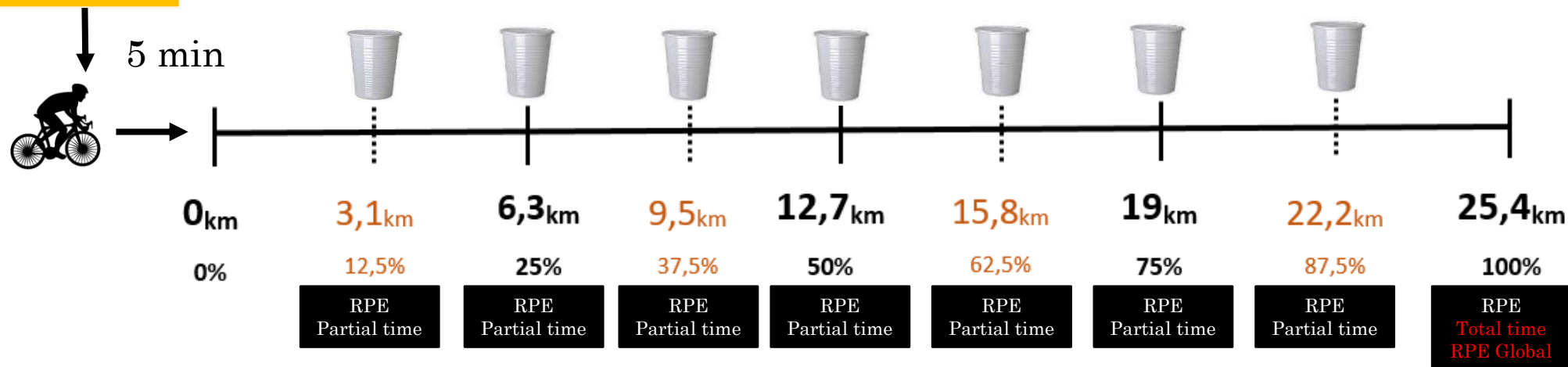
# Experimental protocol



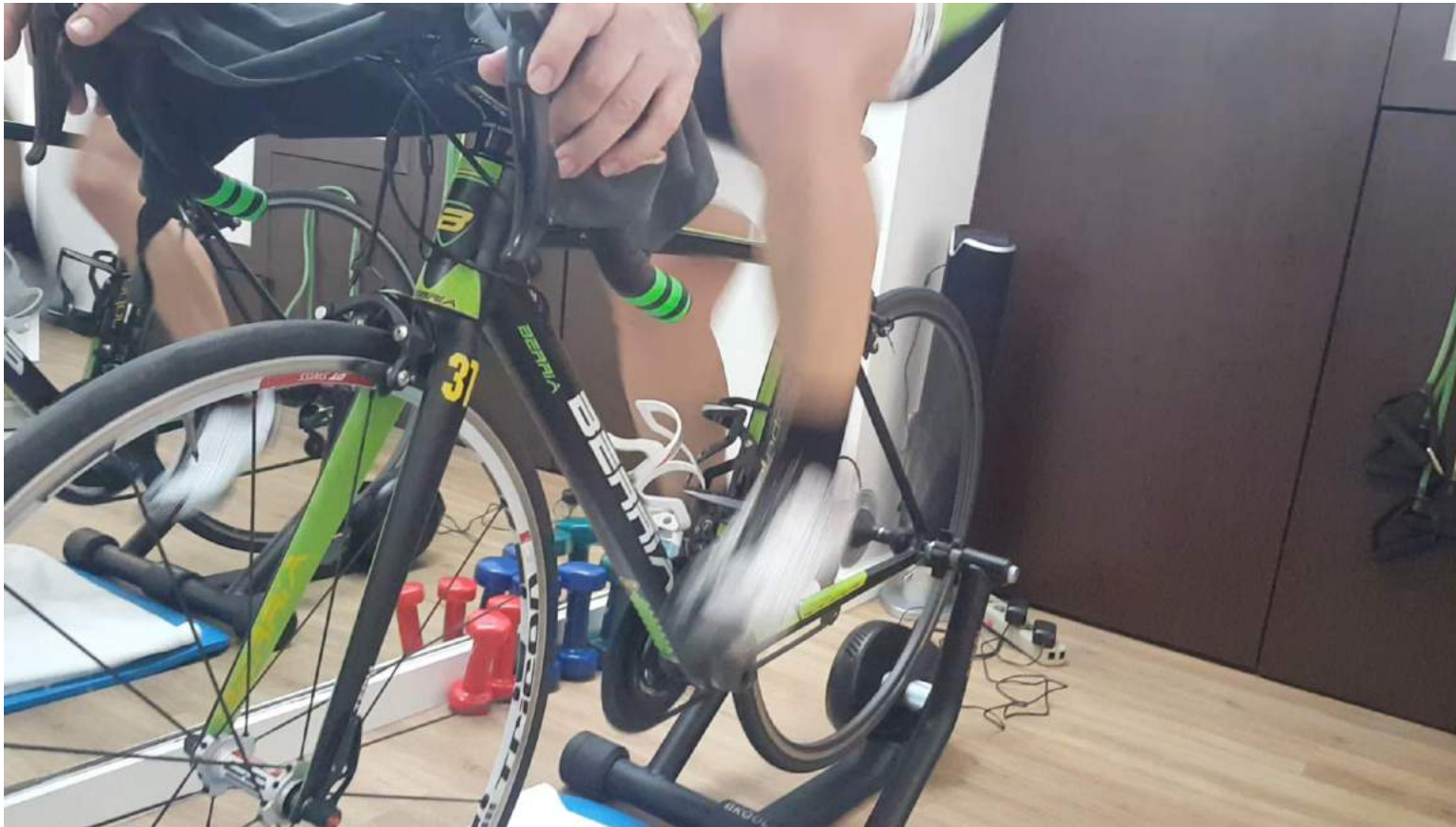
5 sec  
25ml



## Warm-up



# Materials and methods



3D virtual training simulator  
(SMART PRO®, BKOOL, Spain)

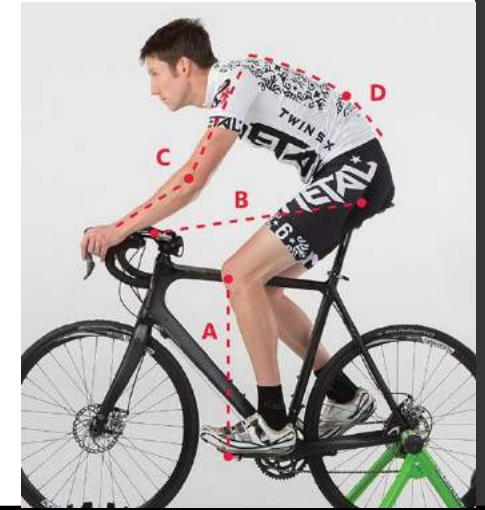
# Materials and methods





# Indoor Trainer

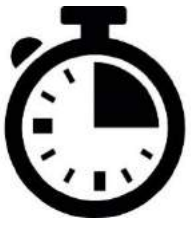
- **CHO Mouth Rinse studies**
  - Lane et al. (2013)<sup>1</sup>
- **Other studies**
  - Mallol-Soler et al. (2017)<sup>2</sup>



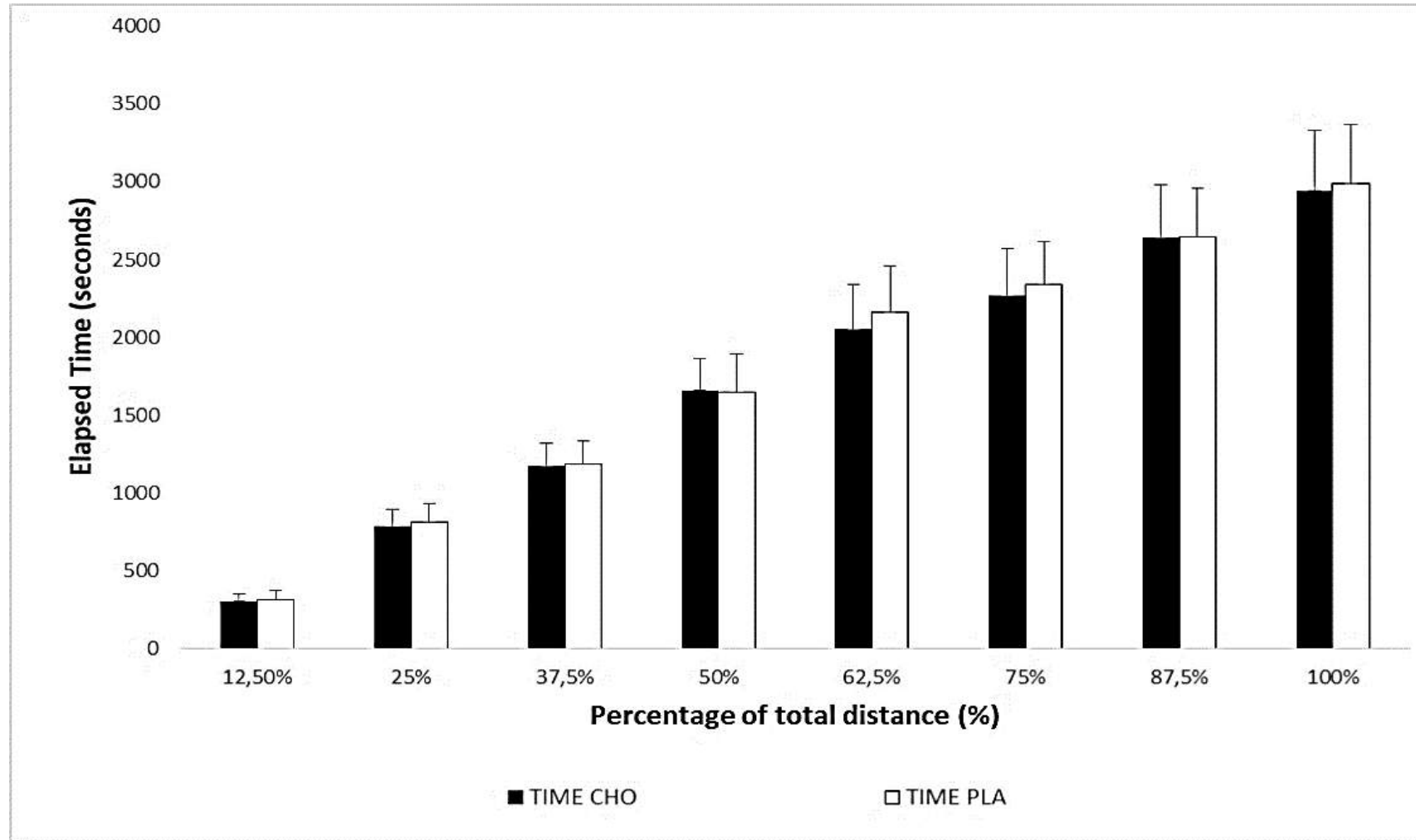
**To allow subjects to use their own bikes  
Already adjusted to the subject  
More realistic pedaling and performance**

<sup>1</sup> Lane, S. C., Bird, S. R., Burke, L. M., & Hawley, J. A. (2013). Effect of a carbohydrate mouth rinse on simulated cycling time-trial performance commenced in a fed or fasted state. *Appl Physiol Nutr Metab*, 38(2), 134-139.

<sup>2</sup> Mallol Soler, M. M., Mejuto, G., Bentley, D., Norton, L., Torres-Unda, J., Arrieta, H., & Otxoteko, I. (2017). Effects of 4 weeks high-intensity training on running and cycling performance in well-trained triathletes. *J Sci Med Sport*, 20, e18.



# Results



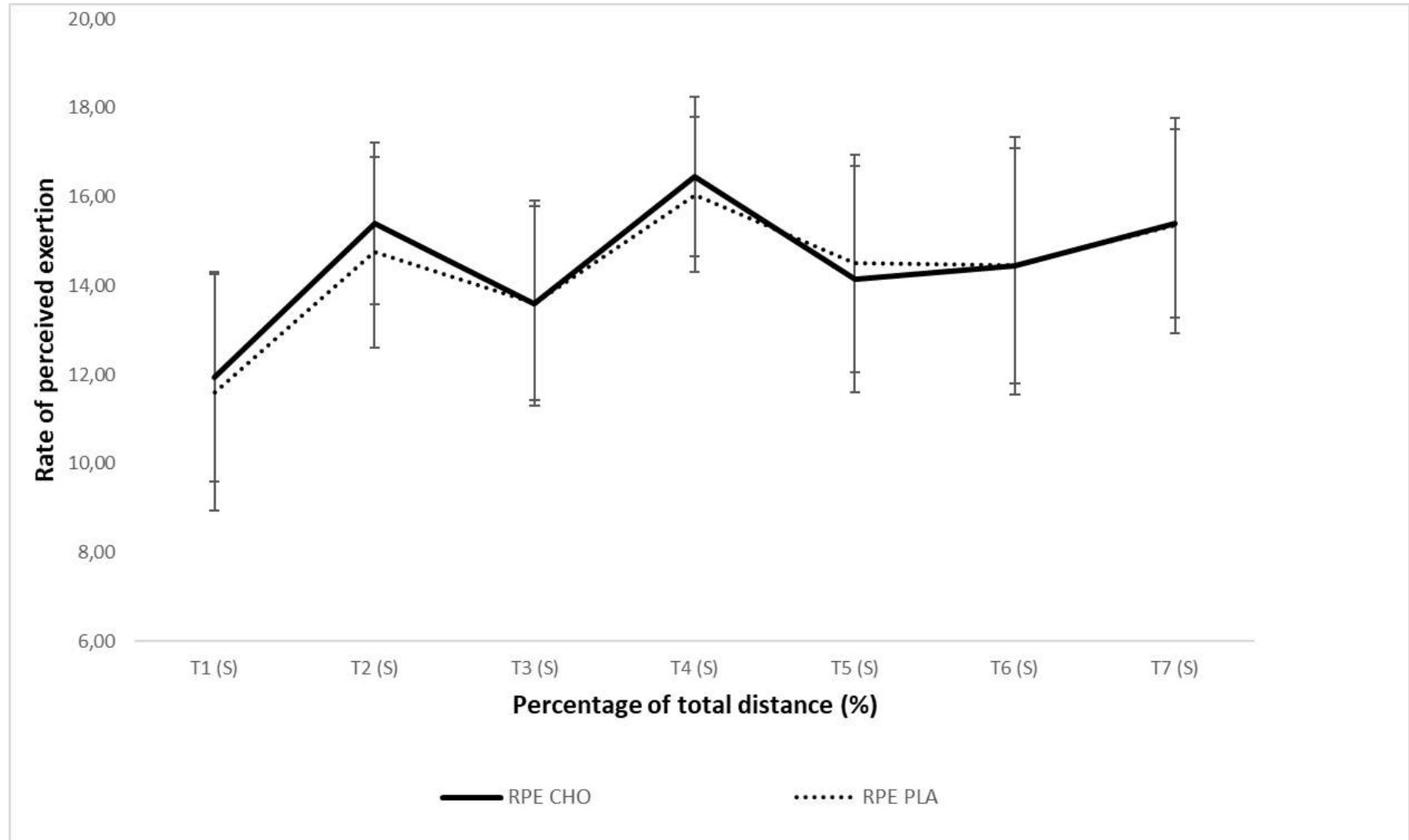
| Variable             | Substance | Mean ± SE     | % Dif | ES   | P value |
|----------------------|-----------|---------------|-------|------|---------|
| Total time (seconds) | CHO       | 2941 ± 391    | -1.4% | 0.12 | 0.252   |
|                      | PLA       | 2986 ± 383    |       |      |         |
| APO (W)              | CHO       | 223.8 ± 50.69 | 2.5%  | 0.12 | 0.280   |
|                      | PLA       | 218.4 ± 47.3  |       |      |         |
| CPO (W)              | CHO       | 241.6 ± 45.5  | 3.2%  | 0.18 | 0.116   |
|                      | PLA       | 234.1 ± 42.6  |       |      |         |
| PPO (W)              | CHO       | 729.4 ± 270.5 | 4.8%  | 0.14 | 0.375   |
|                      | PLA       | 695.8 ± 235.4 |       |      |         |
| RPE                  | CHO       | 16.00 ± 1.34  | 4.2%  | 0.37 | 0.061   |
|                      | PLA       | 15.35 ± 1.76  |       |      |         |

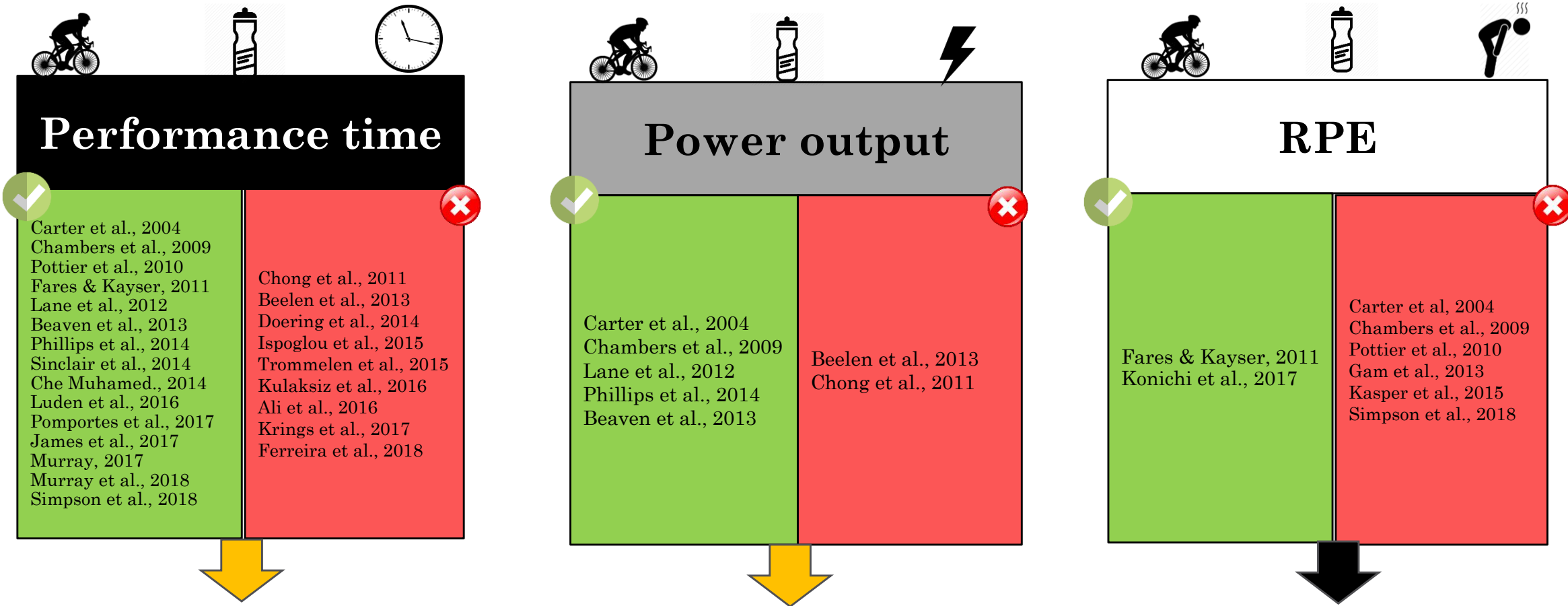
APO = Average power output; CPO = Climbing power output; PPO: Peak power output; RPE: Rate of perceived exertion; W = Watts;





|    |                  |
|----|------------------|
| 6  | No exertion      |
| 7  |                  |
| 8  |                  |
| 9  |                  |
| 10 |                  |
| 11 | Light            |
| 12 |                  |
| 13 | Somewhat hard    |
| 14 |                  |
| 15 | Hard (heavy)     |
| 16 |                  |
| 17 | Very hard        |
| 18 |                  |
| 19 |                  |
| 20 | Maximal exertion |





- Meal preceding the trials Fed VS Fasted – Glycogen stores
- Triall duration < to the majority of the investigation
- Subjects training level might have been inferior to other studies

**Workload protocol**  
Maximum VS constant



Trial duration



Subjects training level



Absence of a “no rinse” control group





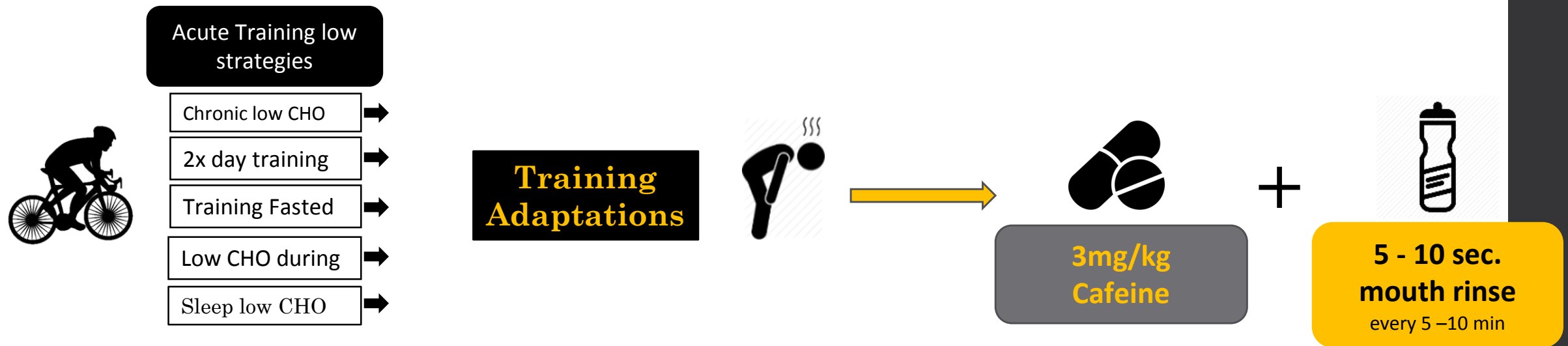
# Conclusion

Mouth rinsing with a mixed CHO solution did not improve performance time of a cycling time trial in moderately trained cycling males, nor it affected significantly power output variables and rate of perceived exertion.



# Take home message

- Contrarily to our results, evidence so far shows that **CHO mouth rinse improves exercise performance (when compared to placebo)**, especially in the fasted state.
- CHO mouth rinse might be a plausible strategy to minimize negative effects of training low strategies, although the effects on amateur trained athletes in the fed state are not clear.







Escuela Universitaria  
Real Madrid  
Universidad Europea




 **Universidad  
Camilo José Cela**



*[fuelthepedal.com](http://fuelthepedal.com)*



**@gabrynutrisports**

   **realmadridue**



**Science & Cycling**  
4-5 Juli 2018, Nantes, França

Gabriel Martins MSc. Sports Nutritionist | [jgsoares@ucjc.edu](mailto:jgsoares@ucjc.edu)  
Juan Del Coso, PhD. Exercise Physiology | [idelcoso@ucjc.edu](mailto:idelcoso@ucjc.edu)

 **Universidad  
Camilo José Cela**



 **Escuela Universitaria  
Real Madrid**  
Universidad Europea

