



Physiological effects of intermittent exogenous ketosis in endurance exercise performance

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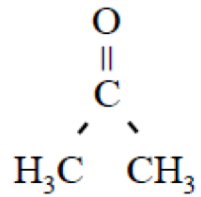
Athletic Performance Center – ‘Bakala Academy’

KU Leuven, Belgium

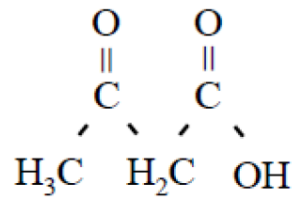
KU LEUVEN



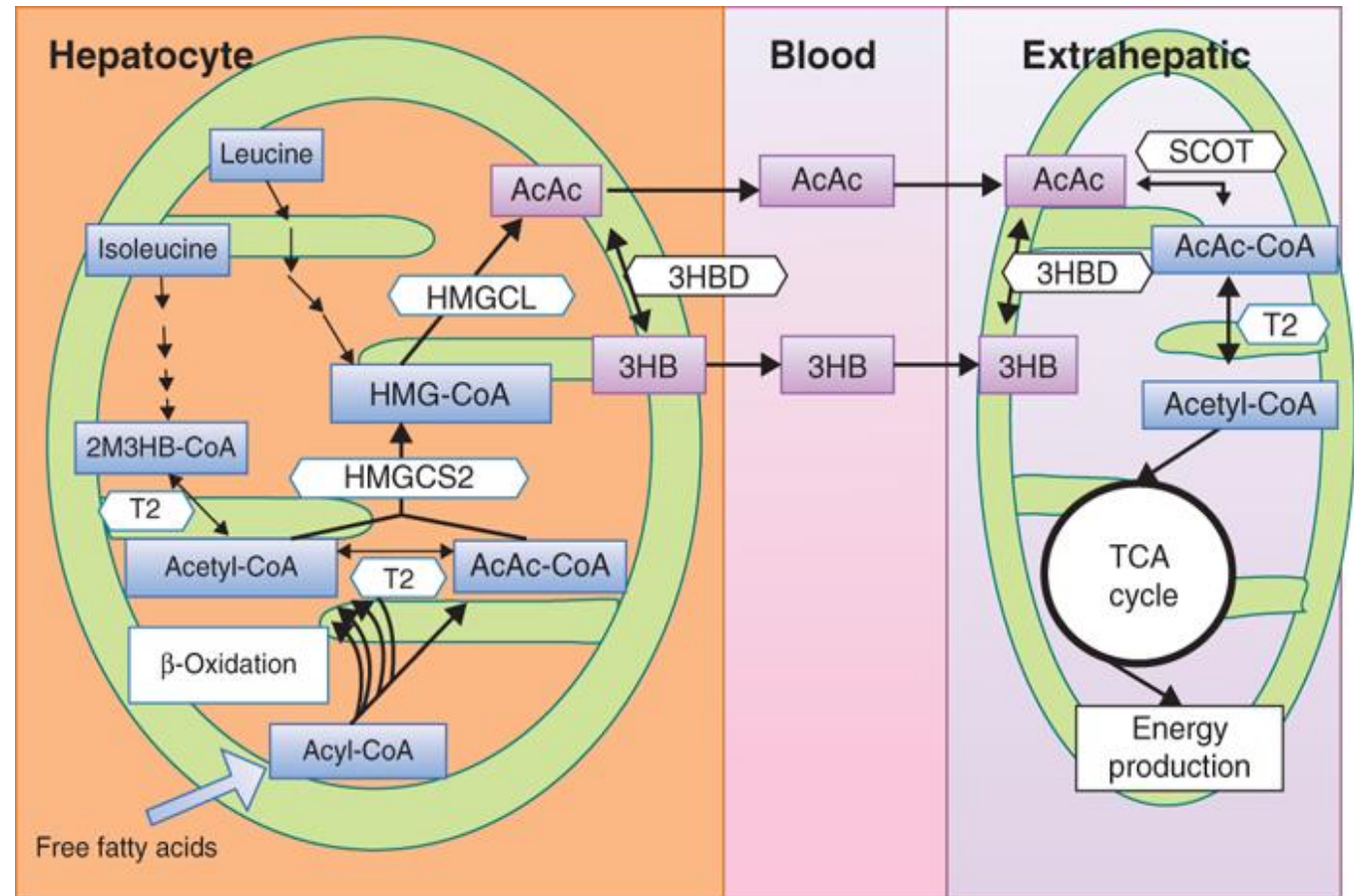
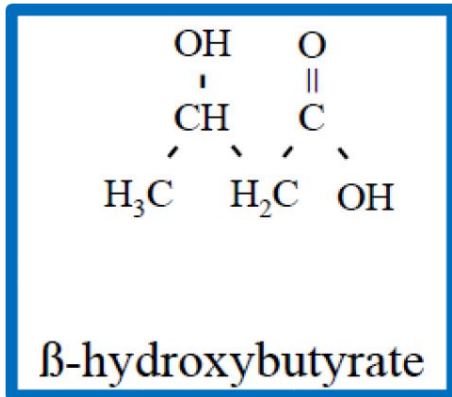
What are ketone bodies?



Acetone

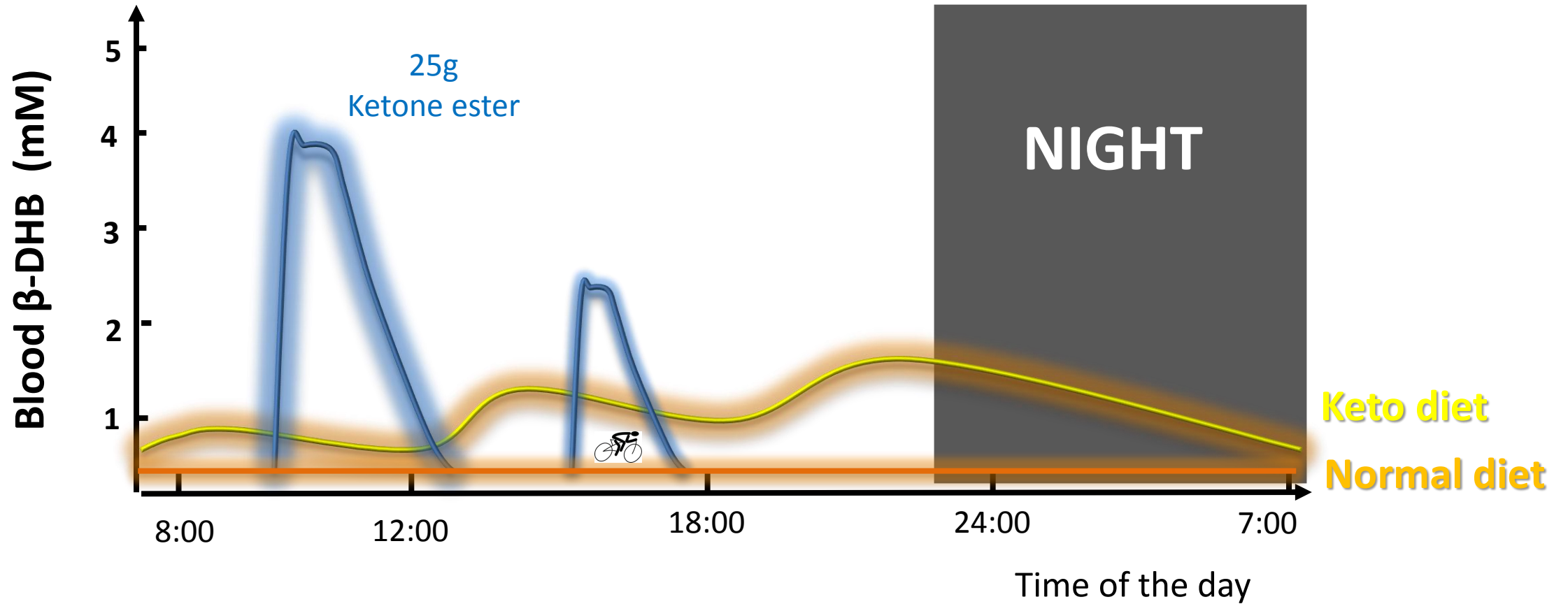


Acetoacetate





Intermittent exogenous ketosis vs. Ketogenic diet



Fake 'keto' supplements



Watch Out for Keto Diet Suppl... | keto supplements - Google Zoel... | +

google.com/search?q=keto+supplements&xsrf=AleKk02Es0NEfauLEMd3gvQaaPpwz0r6g:1608191371259&source=Inms&tbm=isch&sa=X&ved=2ahUKEvjtmqjw91TAhWR2qQKHV6WChMQ_AUoA3oEC...

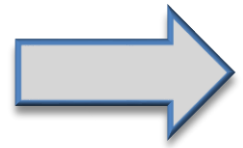
Google keto supplements

<p>24hr Fatburn - Body & Fit - Naturel... € 17,90 €27 Body&Fit</p>	<p>Nutribites Green Juice 300 gram +... € 47,00 Nutribites Gratis verzending</p>	<p>ixX Pharma J-ixX Intense 60... € 32,75 Newpharma.be</p>	<p>Sunwarrior Clean Keto Proteine... € 45,95 Unlimited Health Gratis verzending</p>	<p>Sunwarrior Clean Keto Proteine... € 46,95 Unlimited Health Gratis verzending</p>	<p>Advanced Keto Fuel Shake - SlimFast... € 12,49 €18 Body&Fit</p>	<p>SkinnyLove 2x230 g Farnaline € 82,80 ★★★★ (14) Gratis verzending</p>	<p>Smart Pasta - Body & Fit - Spaghetti... € 1,30 €2 Body&Fit</p>	<p>Concap Sport 450mg 180... Farnaline € 27,44</p>
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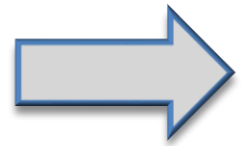
<p>Amazon.com: Nutriana Ke... amazon.com</p>	<p>Amazon.com: Best Keto Slim Di... amazon.com</p>	<p>Exogenous ketones: Do they wor... dieldoctor.com</p>	<p>Amazon.com: Keto Diet Labs... amazon.com</p>	<p>Amazon.com: Keto Diet Pi... amazon.com</p>	<p>Keto Weight Loss (75 Capsules) by EPI... vitaminshoppe.com · Op voorraad</p>	<p>Amazon.com: Keto Pills Ketosis Diet... amazon.com</p>
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https://www.farnaline.be/apotheek/bestellen/skinnylove/7expa-gs

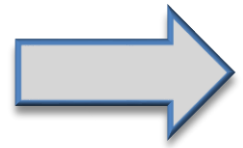
8:50 17/12/2020



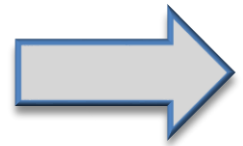
Effects of short/long-term IEK on endurance training adaptation and recovery



Effects of acute ketone ester intake in endurance exercise performance



Effects of short/long-term IEK on endurance training adaptation and recovery



Effects of acute ketone ester intake in endurance exercise performance



TDF induces a catabolic state



*“When mud and dust have been rinsed off,
we look like skeletons.”*

*“Every Tour I loose 6 of my 10 toenails, they
slowly die from stage to stage.”*

“But, they recover by the next year .”



Simulated 'Tour de France'

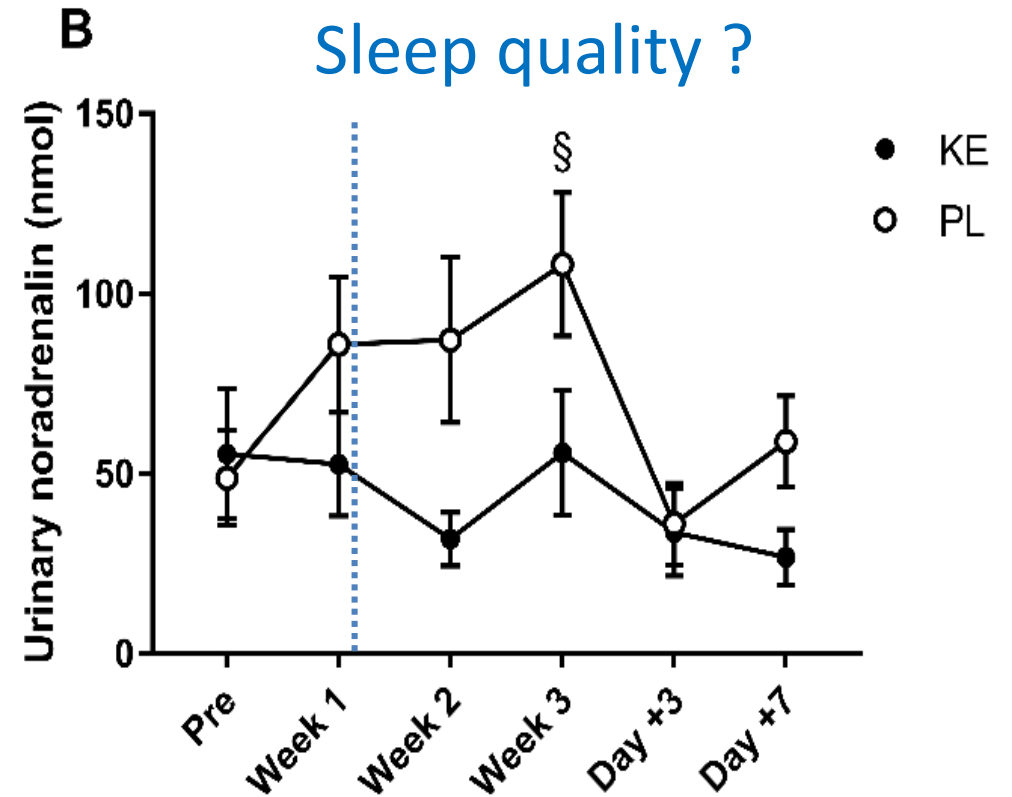
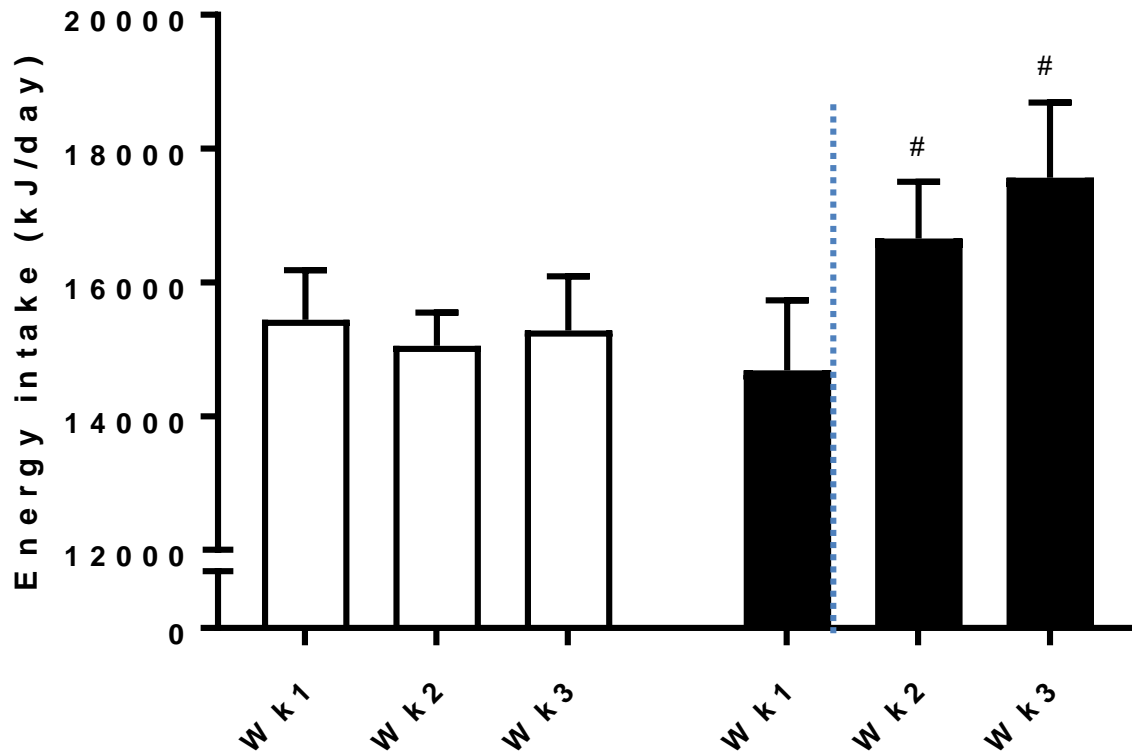
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Week 1	AM	70 min IMT 100/55%	Rest	30 min HIIT	70 min IMT 100/55%	30 min HIIT	70 min IMT 100/55%	<i>Test Wk1</i>
	PM	Rest	Rest	60 min ET 70%	60 min ET 70%	60 min ET 70%	60 min ET 70%	60 min ET 77.5%
Week 2	AM	70 min IMT 100/65%	Rest	30 min HIIT	70 min IMT 105/65%	30 min HIIT	70 min IMT 110/80%	<i>Test Wk2</i>
	PM	Rest	Rest	90 min ET 77.5%	60 min ET 85%	90 min ET 80%	60 min ET 90%	90 min ET 85%
Week 3	AM	120 min HIIT & ET 85%	Rest	70 min IMT 110/80%	120 min ET-TT_{30min} 85% - 30' all-out	70 min IMT 110/80%	70 min IMT 110/85%	<i>Posttest Test Wk3</i>
	PM	Rest	Rest	90 min ET 90%	Rest	120 min ET 95%	150 min HIIT & ET 92.5%	Rest

+ 25g KE/PL doses

2-3 * daily

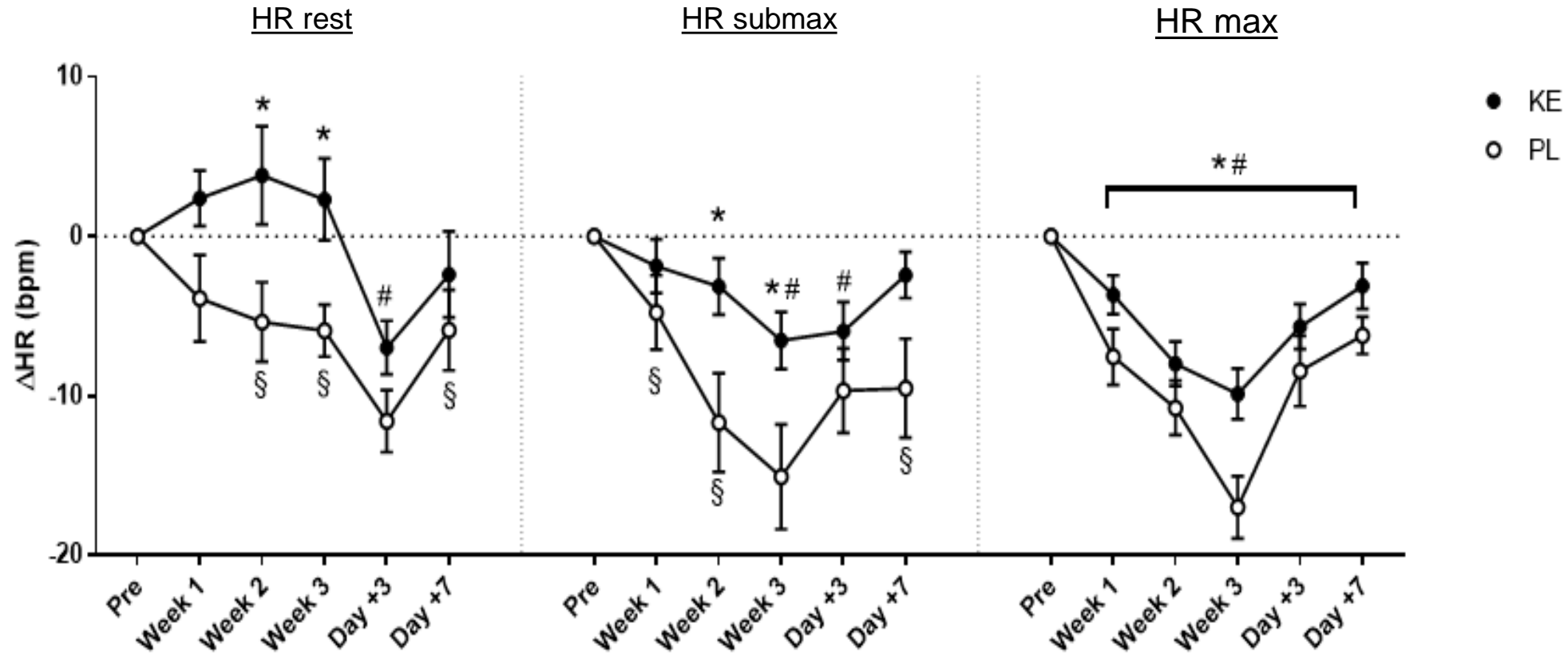


IEK intake stimulated spontaneous energy intake





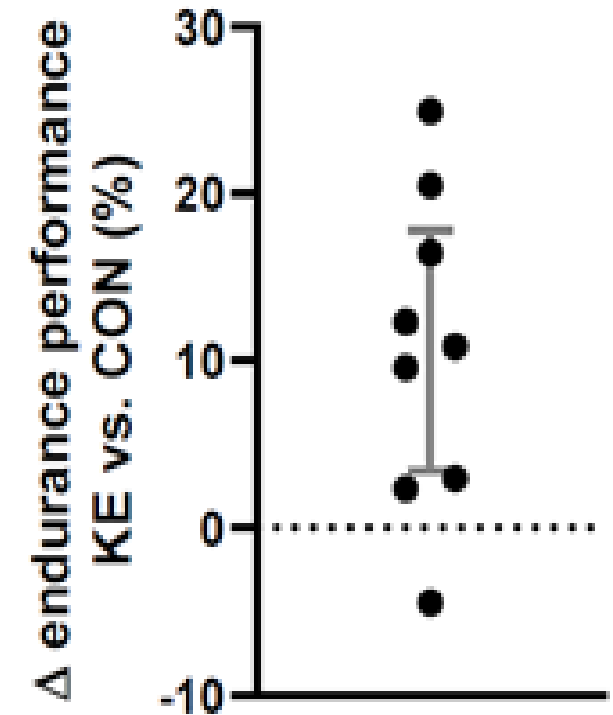
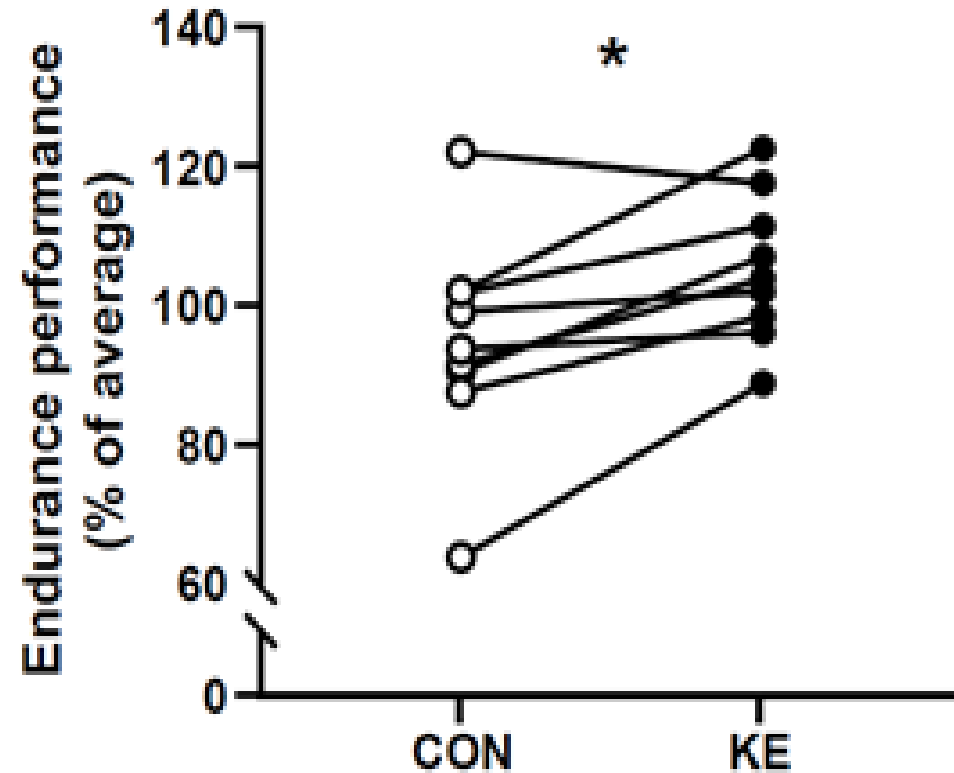
IEK suppressed heart rate drop





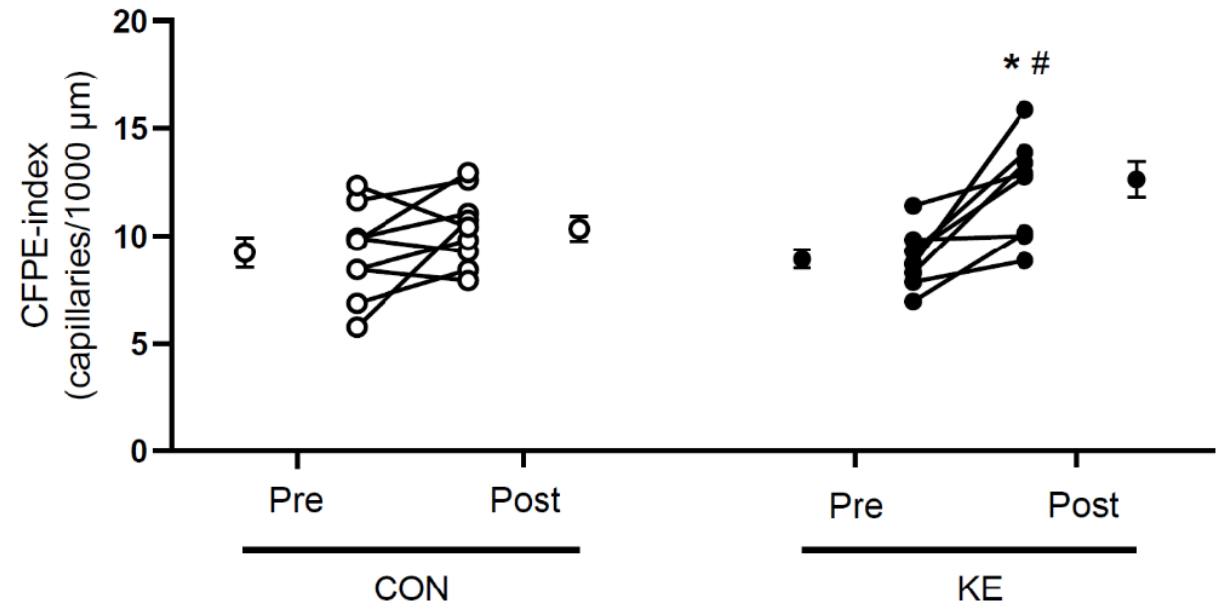
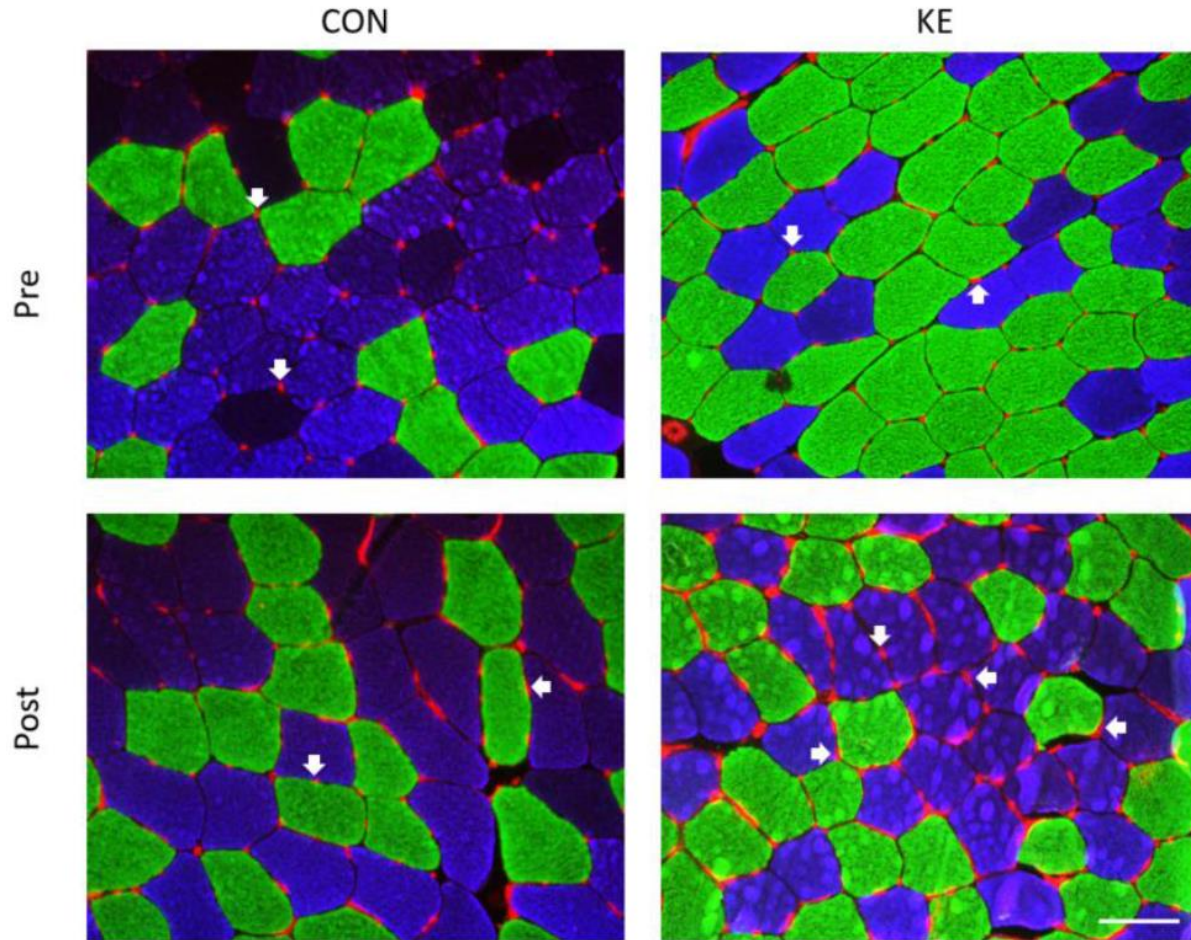
IEK enhanced endurance performance

- Training workload
- 30-min time trial
- 120 min training + 30-min time trial





IEK stimulated muscular angiogenesis





Conclusions: impact of IEK during recovery

ENDURANCE TRAINING OVERLOAD

- Spontaneous energy intake ↑
- Overreaching symptoms ↓
- Basal adrenergic tone ↓
- Muscular angiogenesis ↑

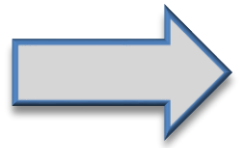
APPETITE

PERFORMANCE

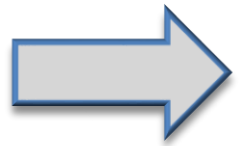
NEUROMODULATION

SIGNALING

ENDURANCE TRAINING OVERLOAD



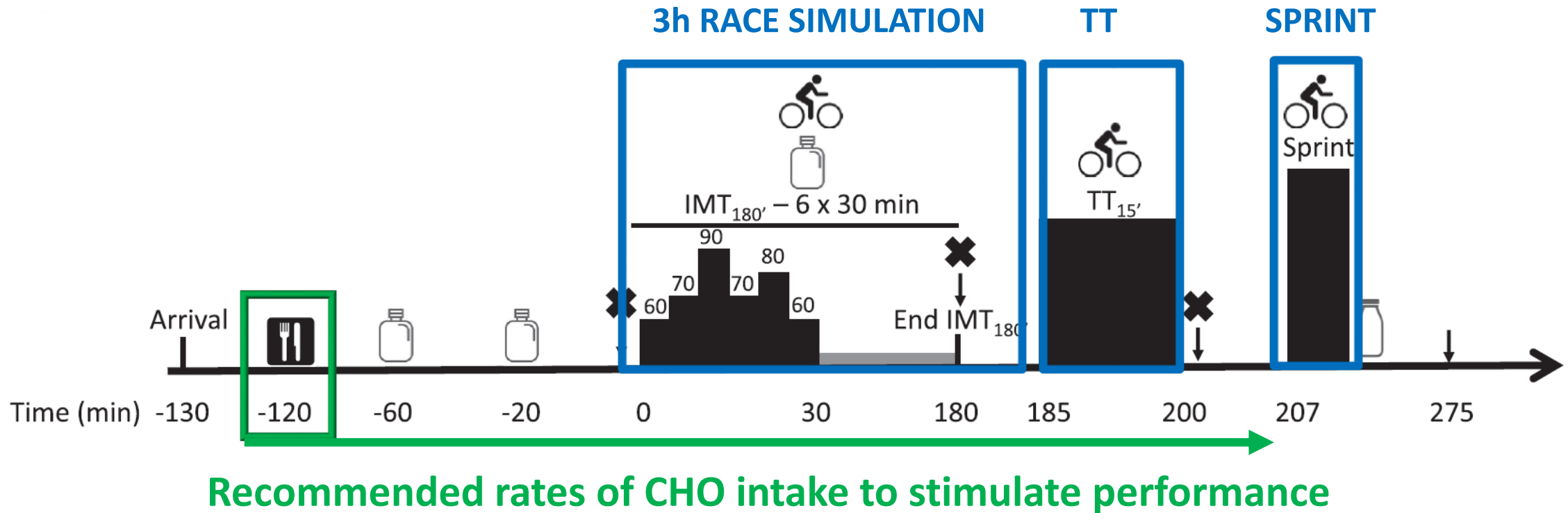
Effects of short/long-term IEK on endurance training adaptation and recovery



Effects of acute ketone ester intake in endurance exercise performance

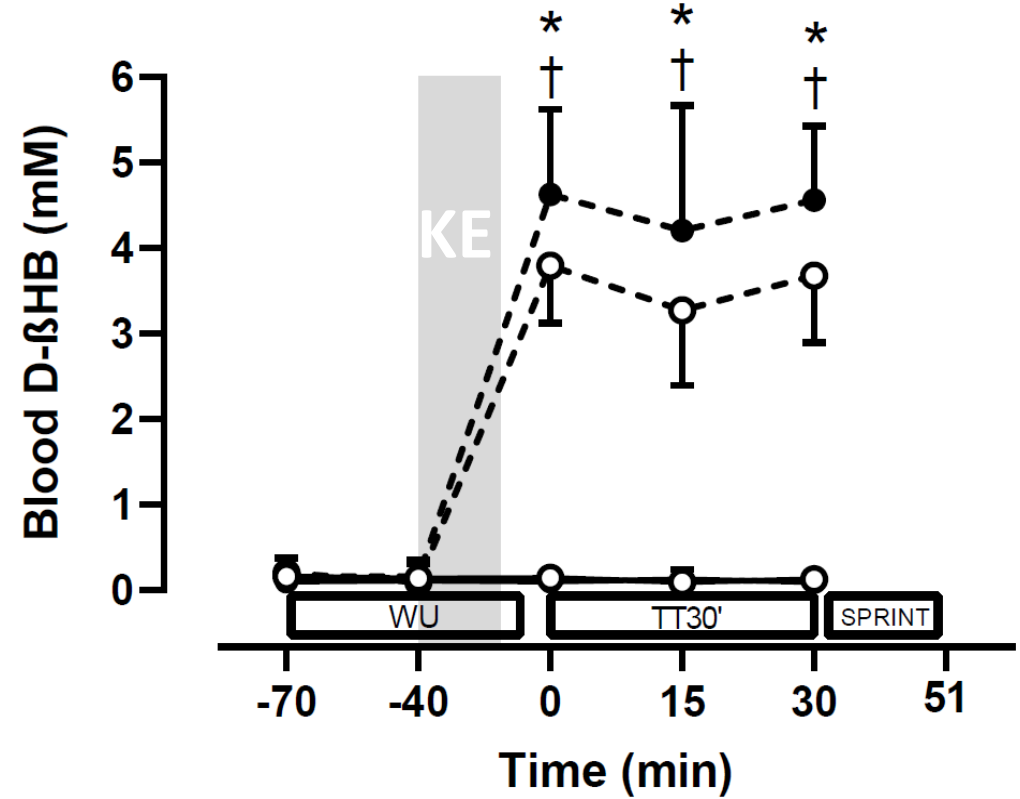
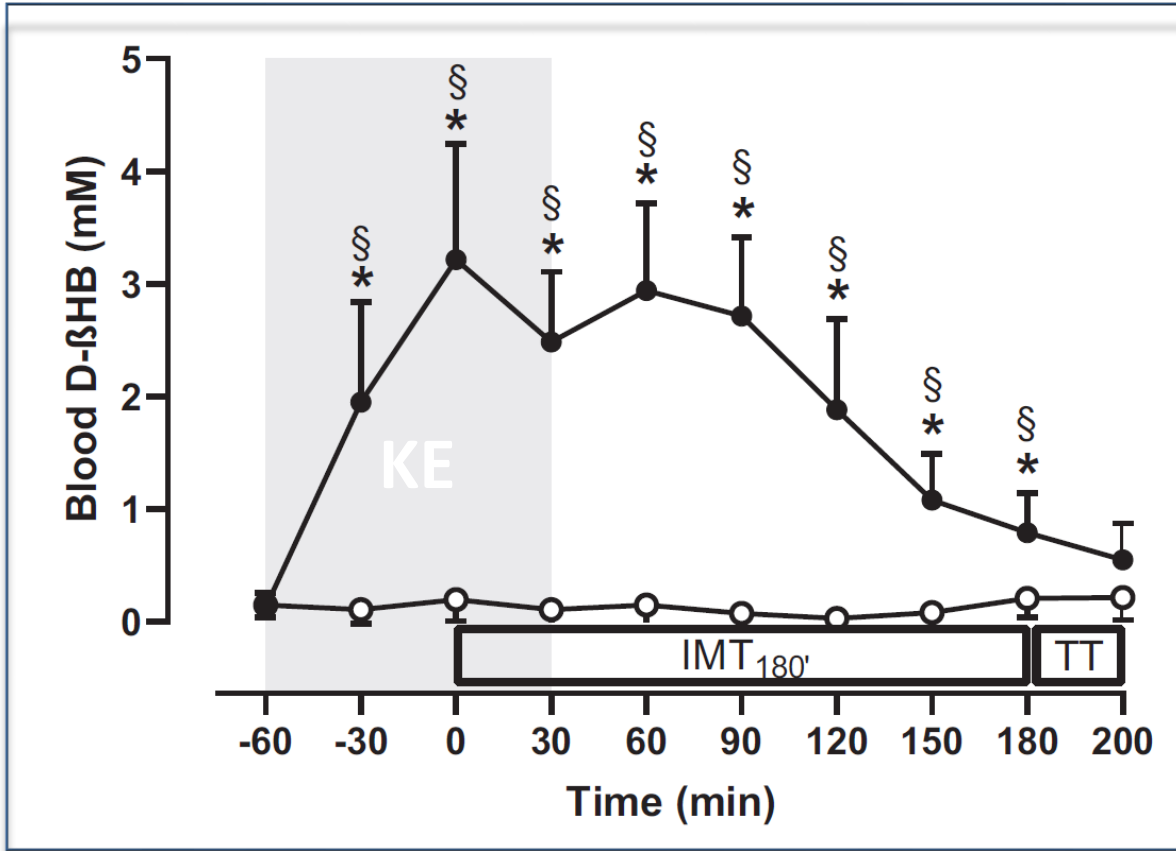


KE intake during simulated cycling races



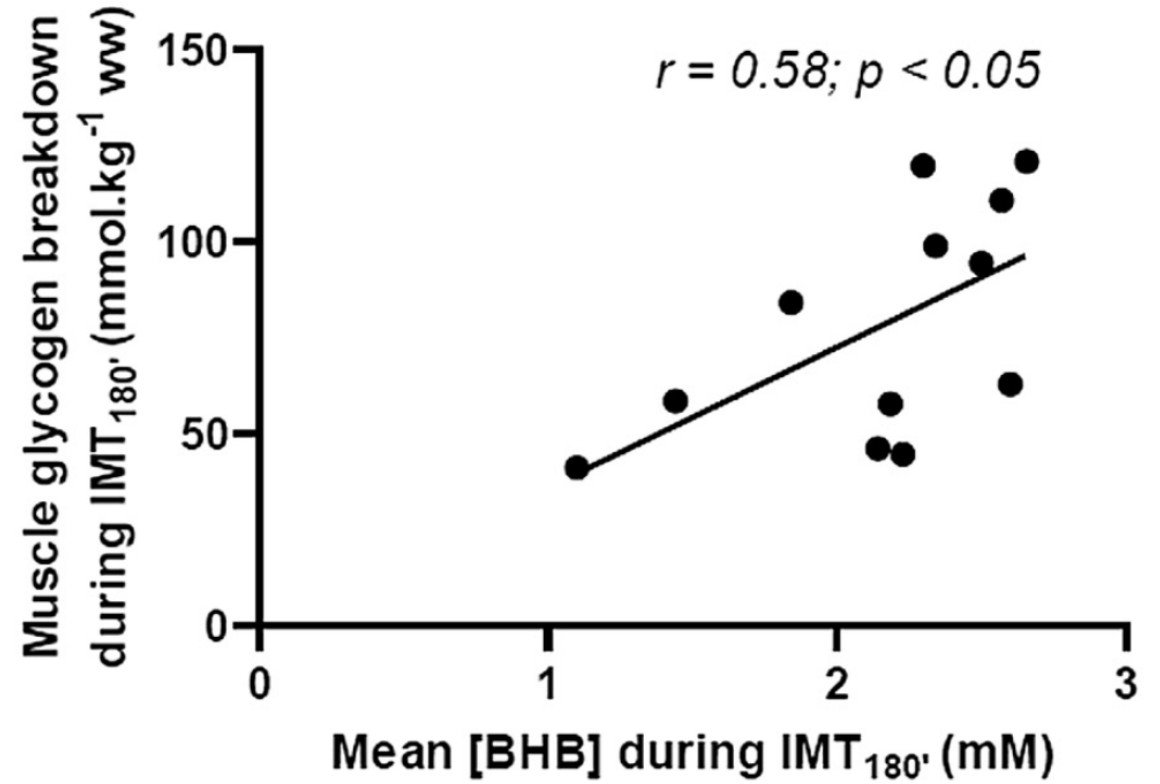
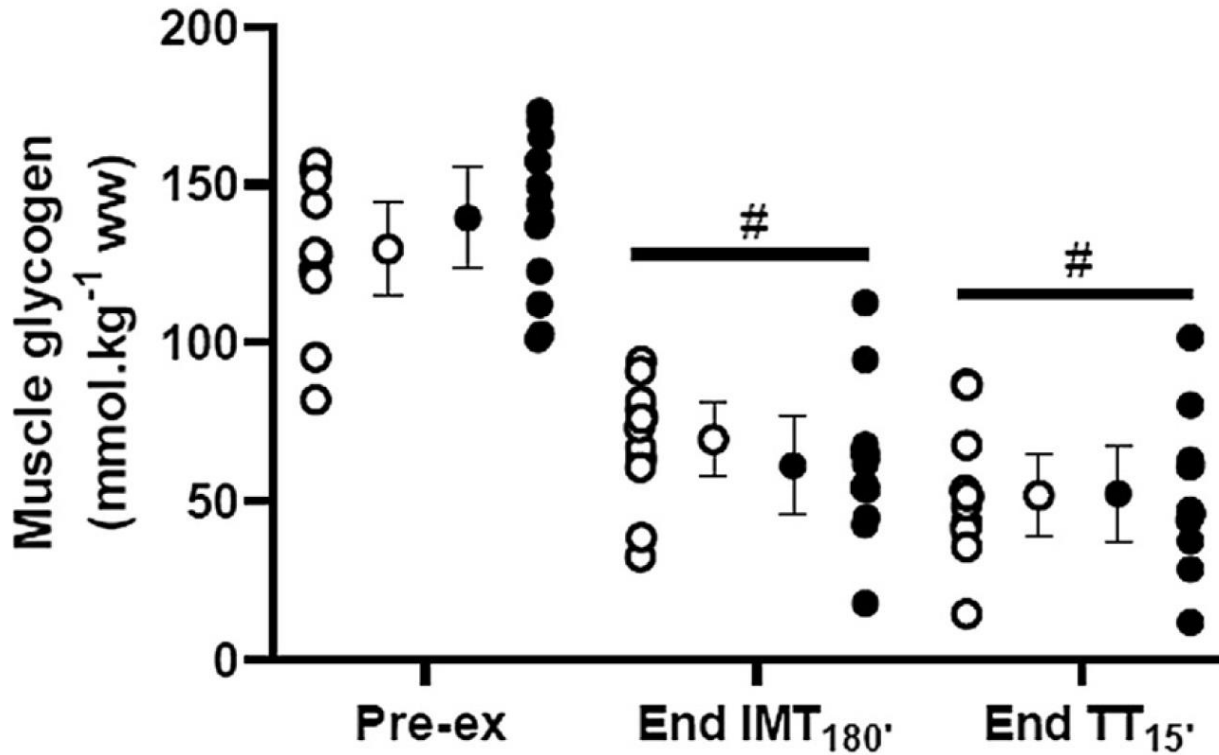


Different KE administration protocols



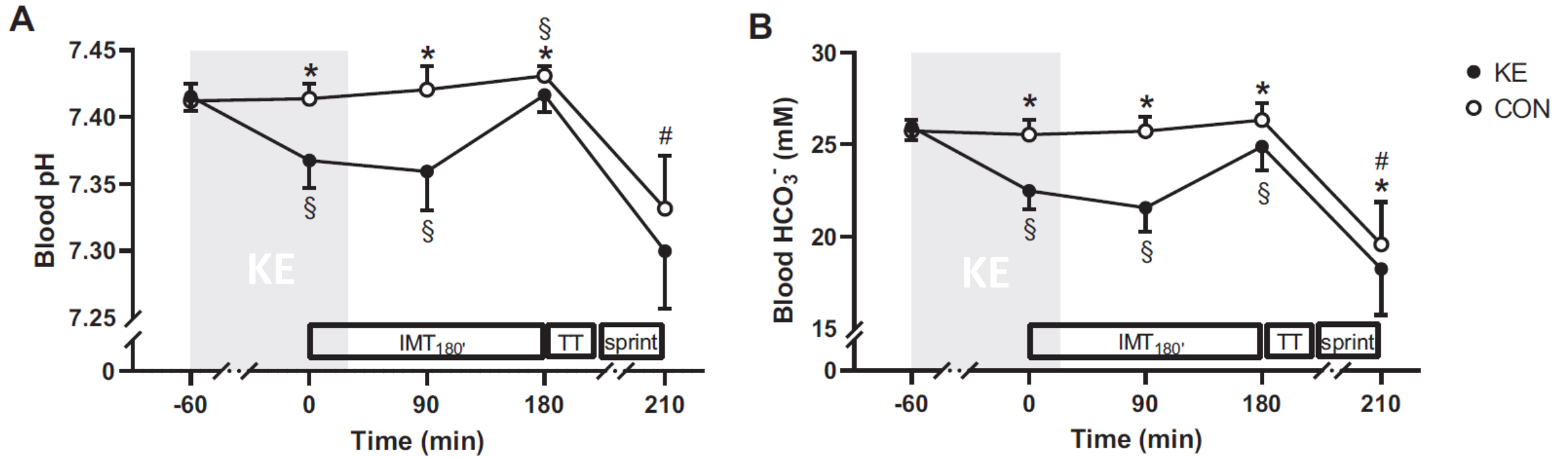


No effect on glycogen breakdown



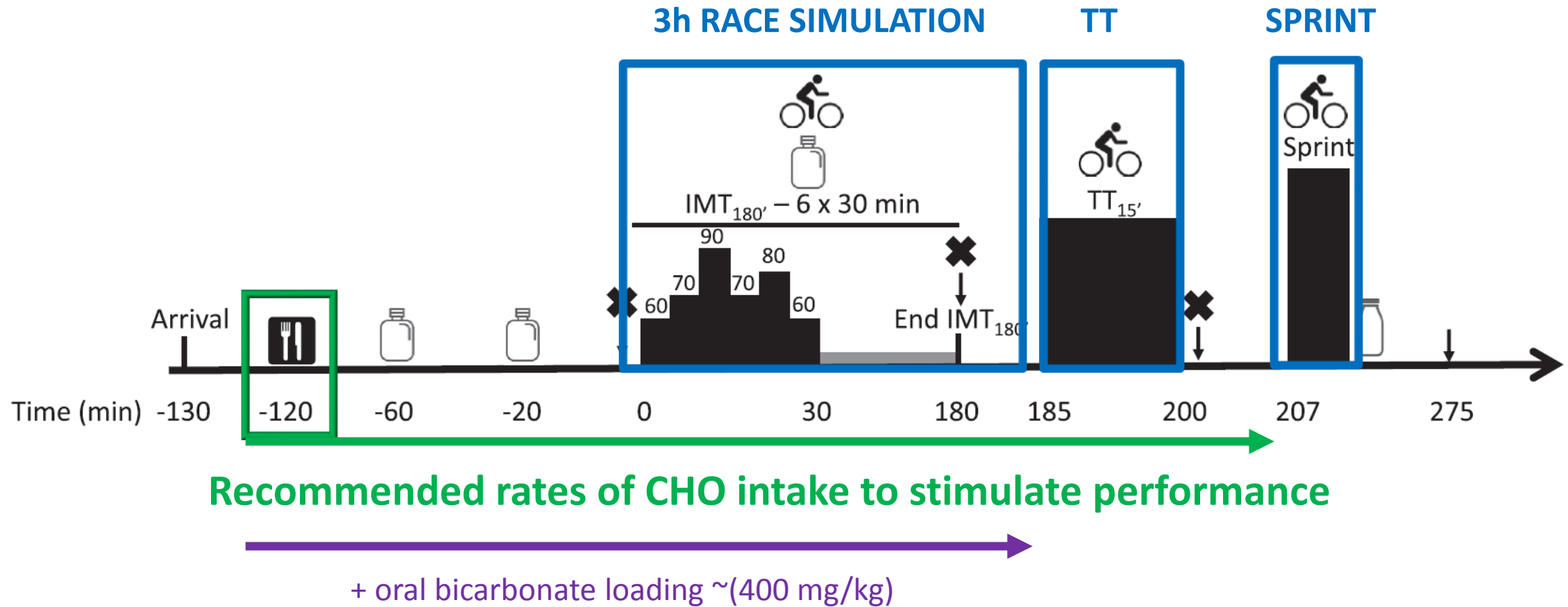


But KE caused acidosis



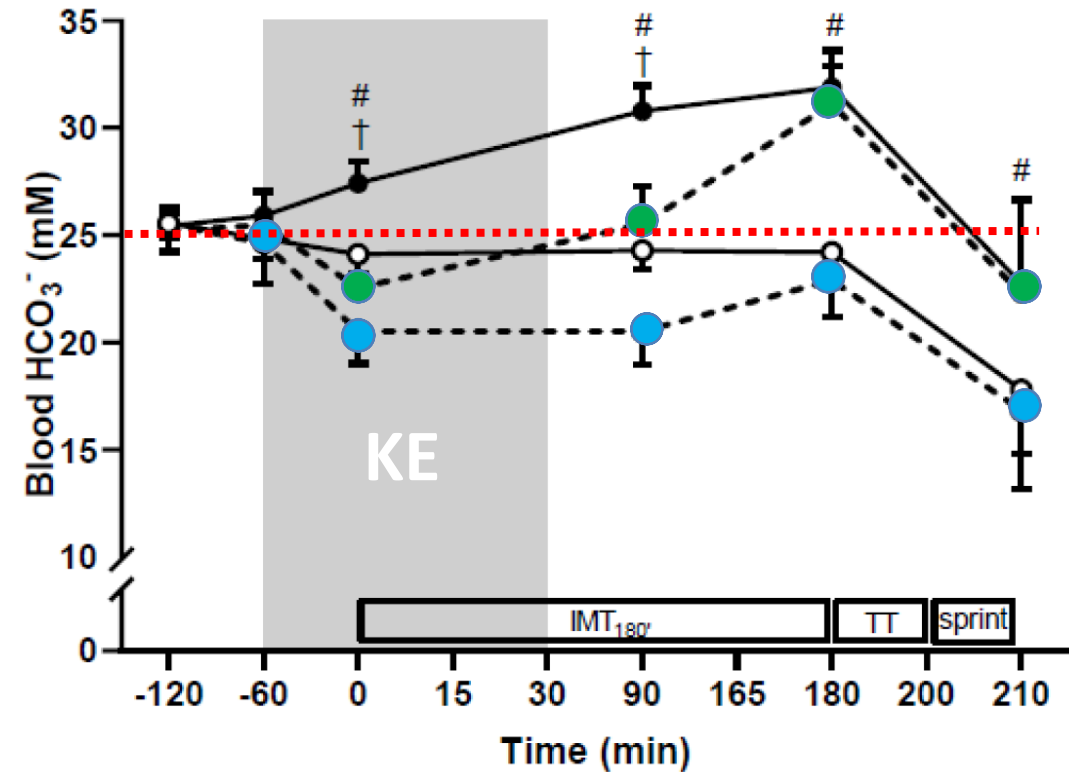
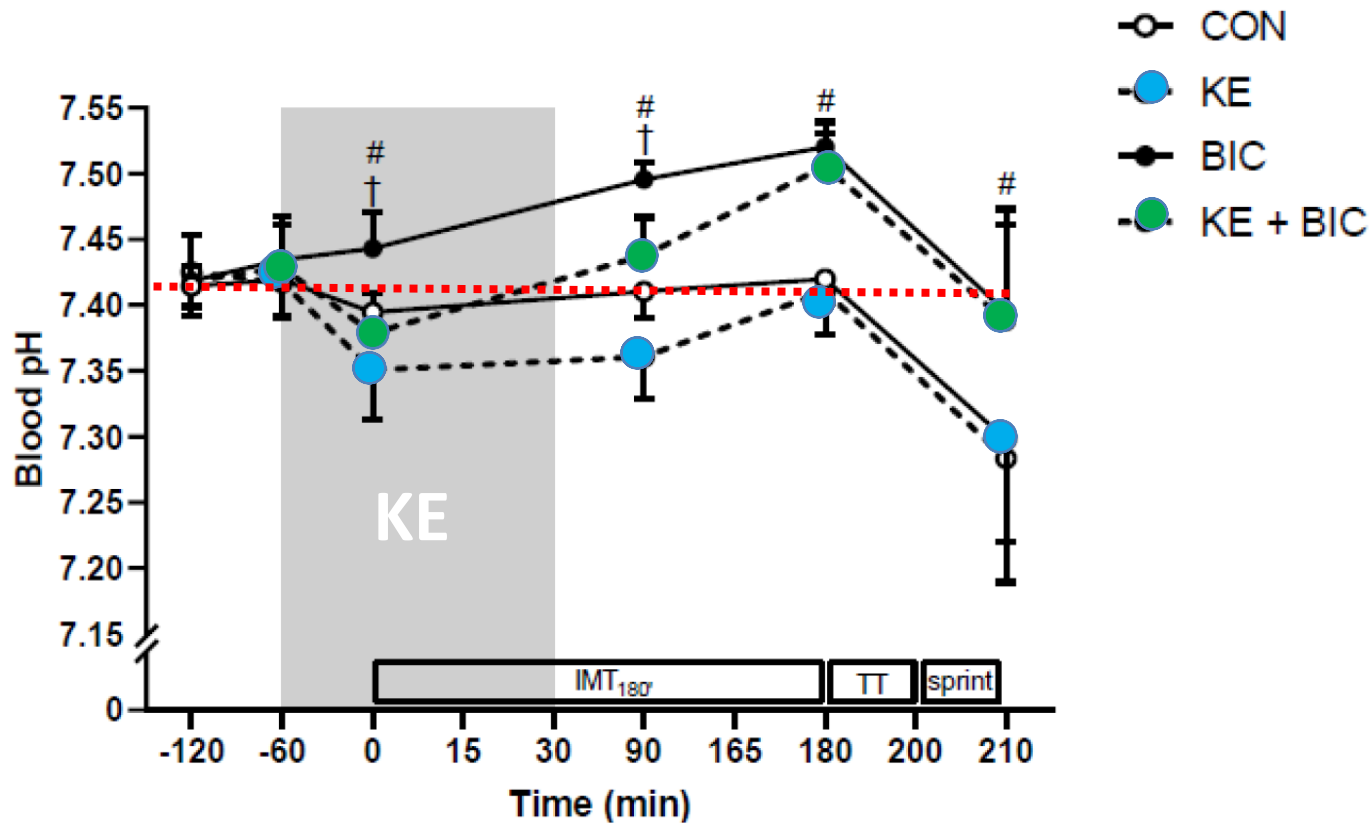


KE intake during simulated cycling races





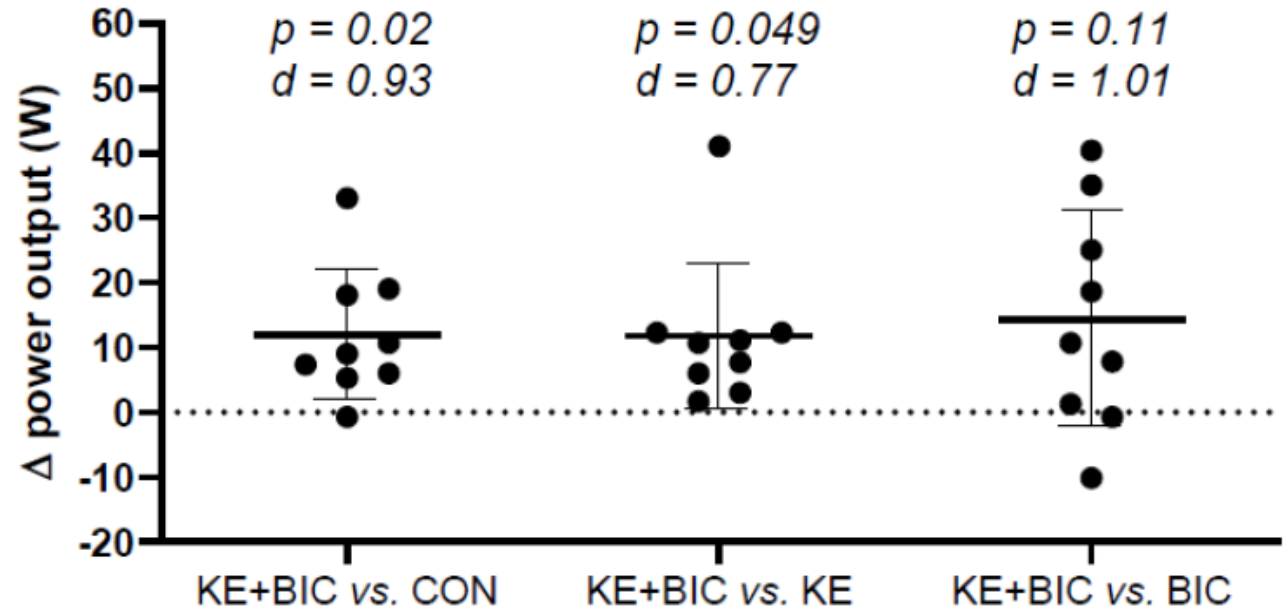
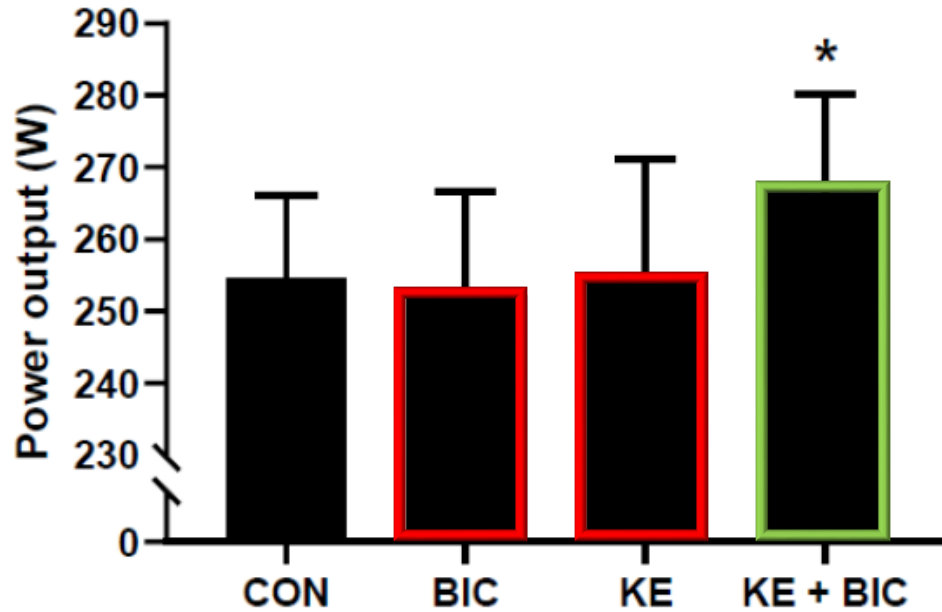
Bicarbonate counteracted KE-induced acidosis





Only KE + BIC improved performance

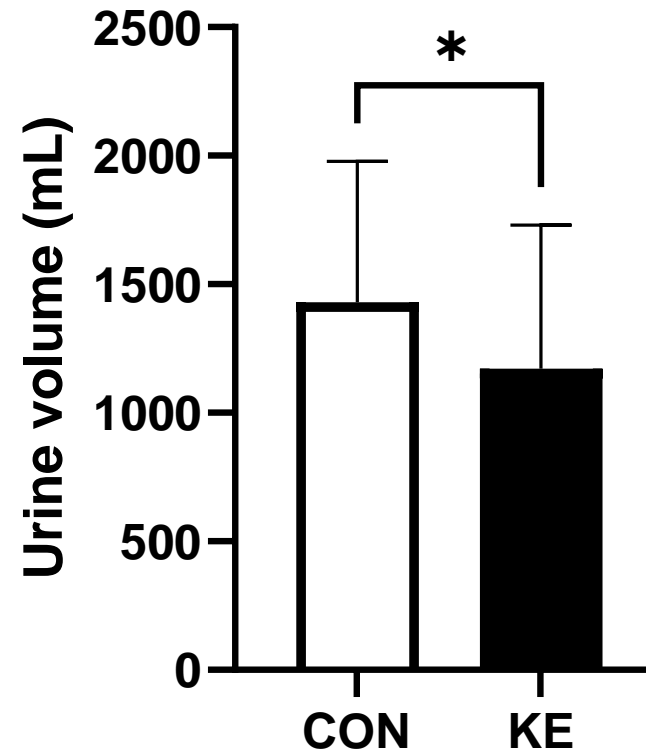
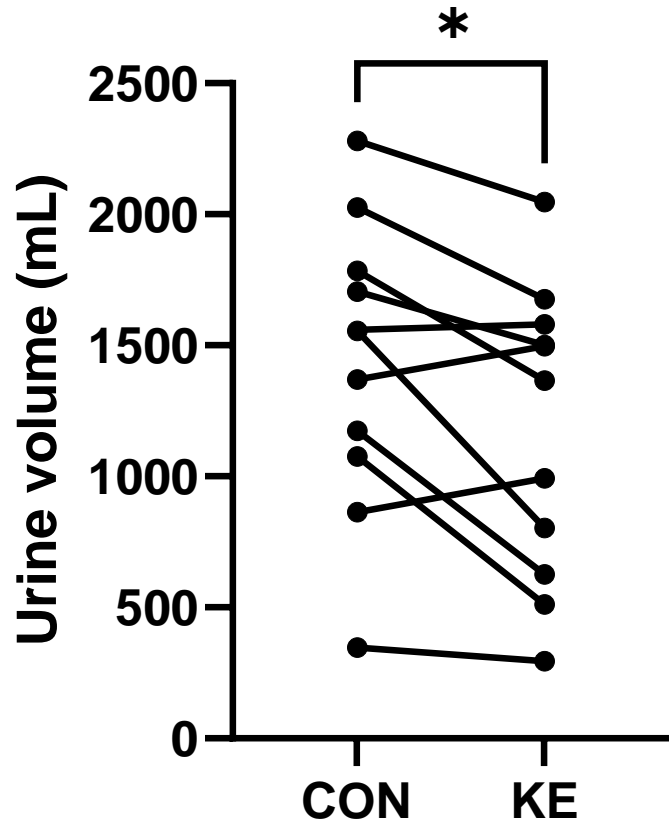
15-min time trial



↑ Blood βHB < 1mM

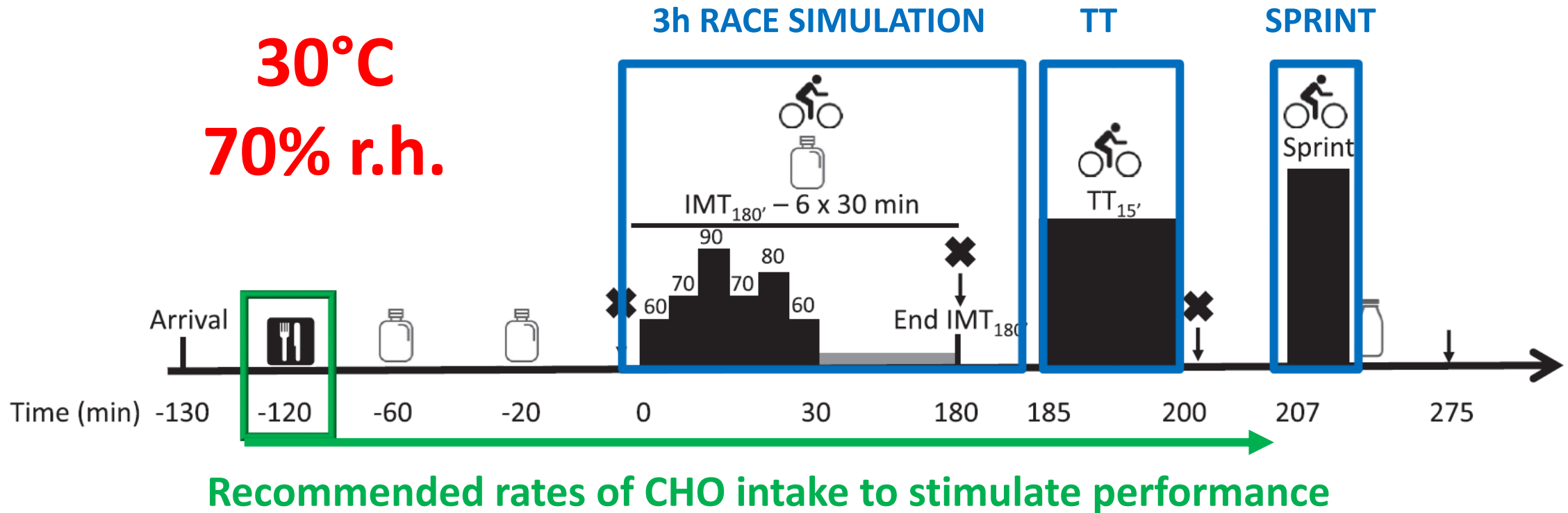


KE exerts an anti-diuretic action during exercise



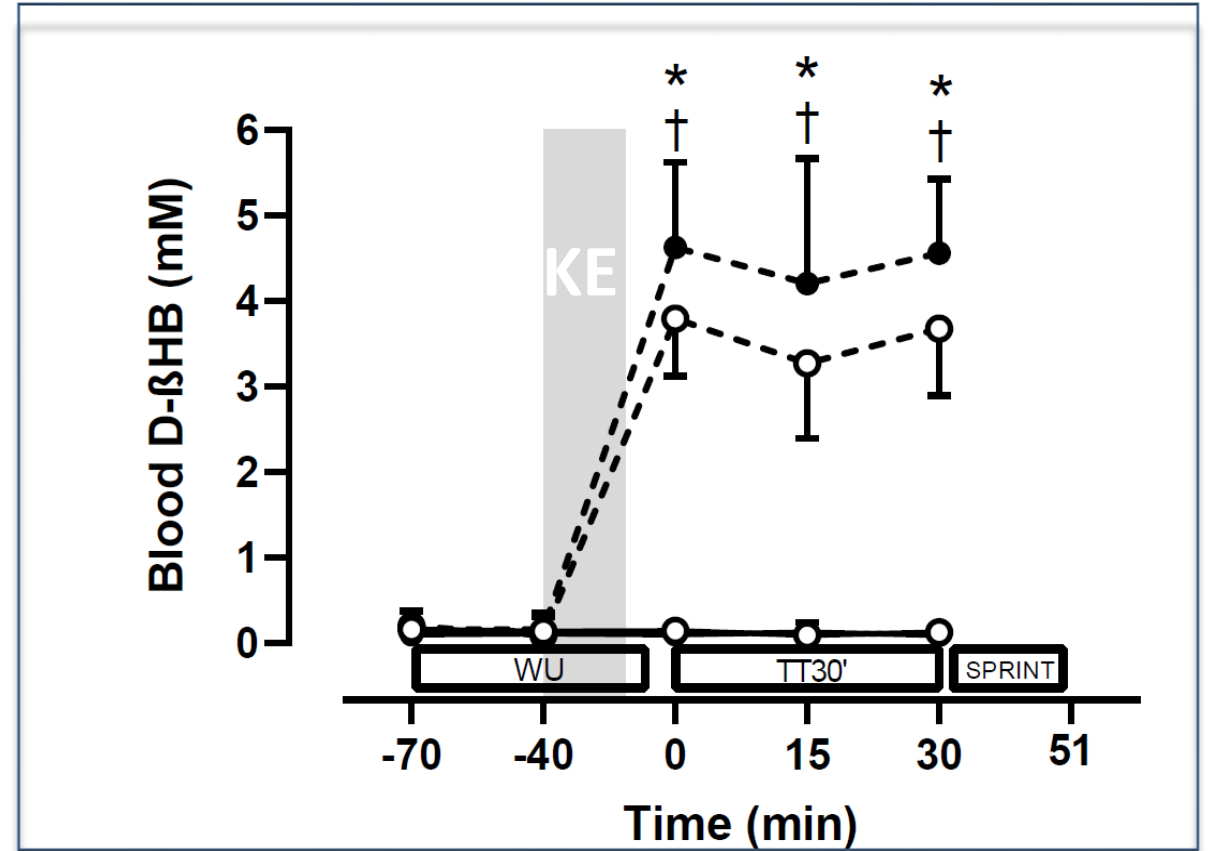
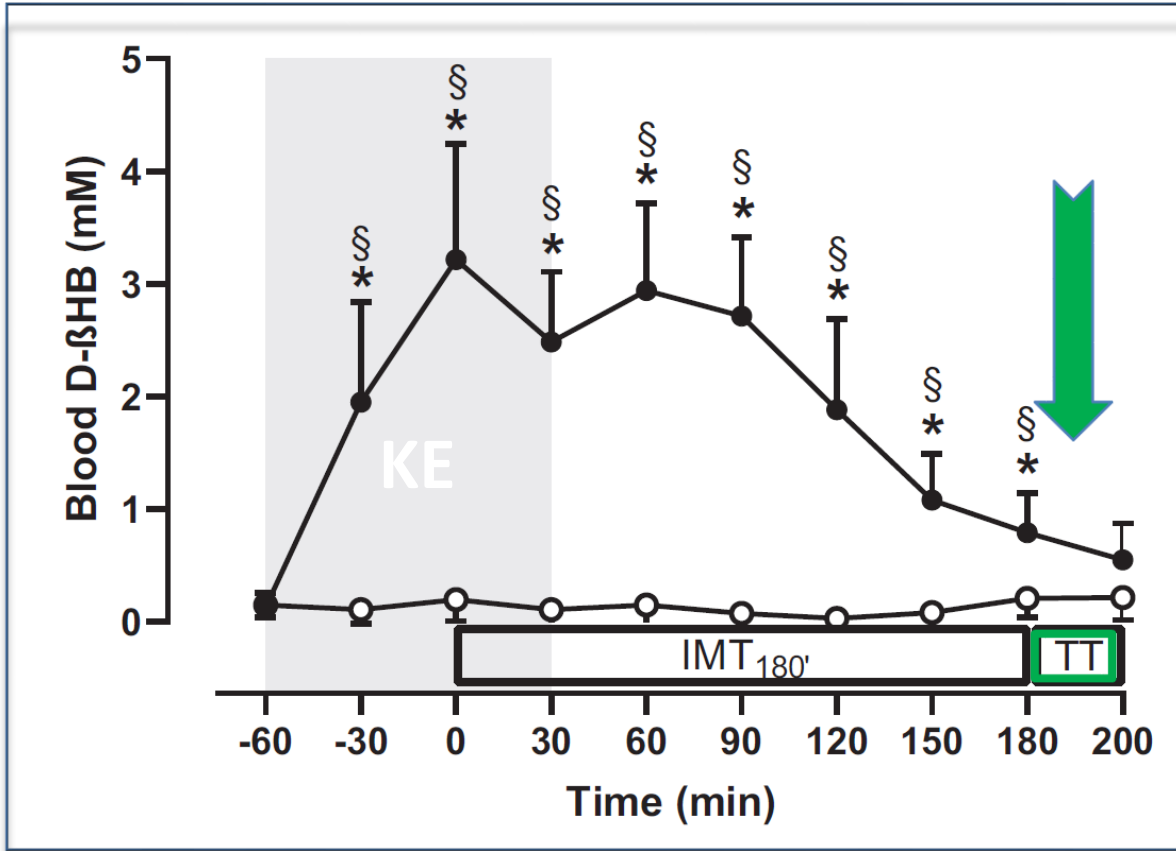


KE intake during simulated cycling races



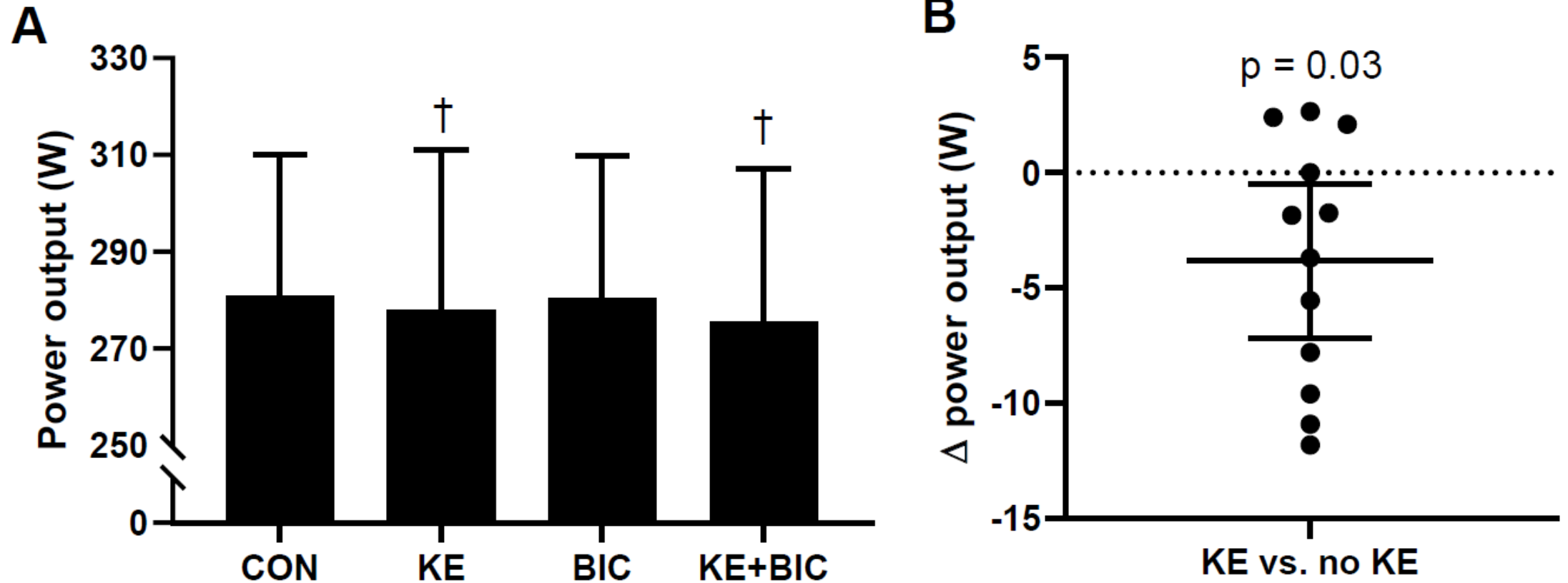


Different KE administration protocols





KE impaired TT_{30min} performance





Impact of KE during exercise

When CHO intake is adequate:

- Marginal role as an energy substrate
 - No evidence for muscle glycogen sparing
-
- Blood pH \searrow \Rightarrow Bicarbonate pool \searrow
 - \searrow Buffer capacity \searrow

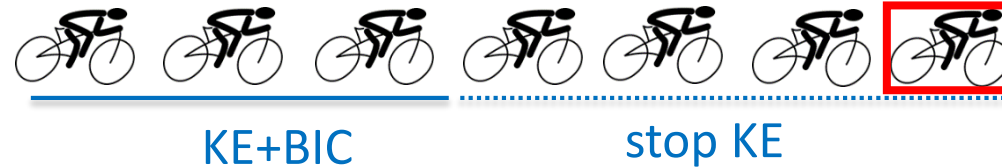


Impact on performance?

When CHO intake is adequate:

KE INGESTION ALONE: no evidence pro

KE + BICARBONATE: some evidence pro



Other nutritional/exercise contexts: Fasted? Ultra? Keto-adapted?