

The impact of low carbohydrate diets on bone in athletes?

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Who am I? My research journey





Bone is a nutritionally modulated tissue – key considerations for athletes (Sale and Elliott-Sale 2019)

⚡ Energy & Carbohydrate availability ⚡

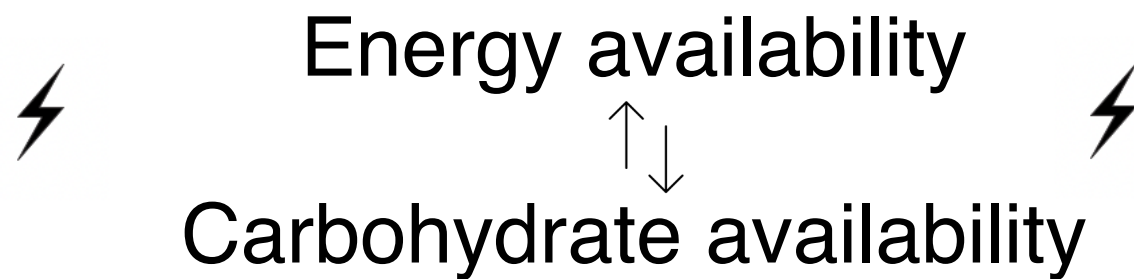
🍷 Protein intake 🍷

☀ Vitamin D ☀

🥛 Calcium 🥛



Bone is a nutritionally modulated tissue – key considerations for athletes (Sale and Elliott-Sale 2019)



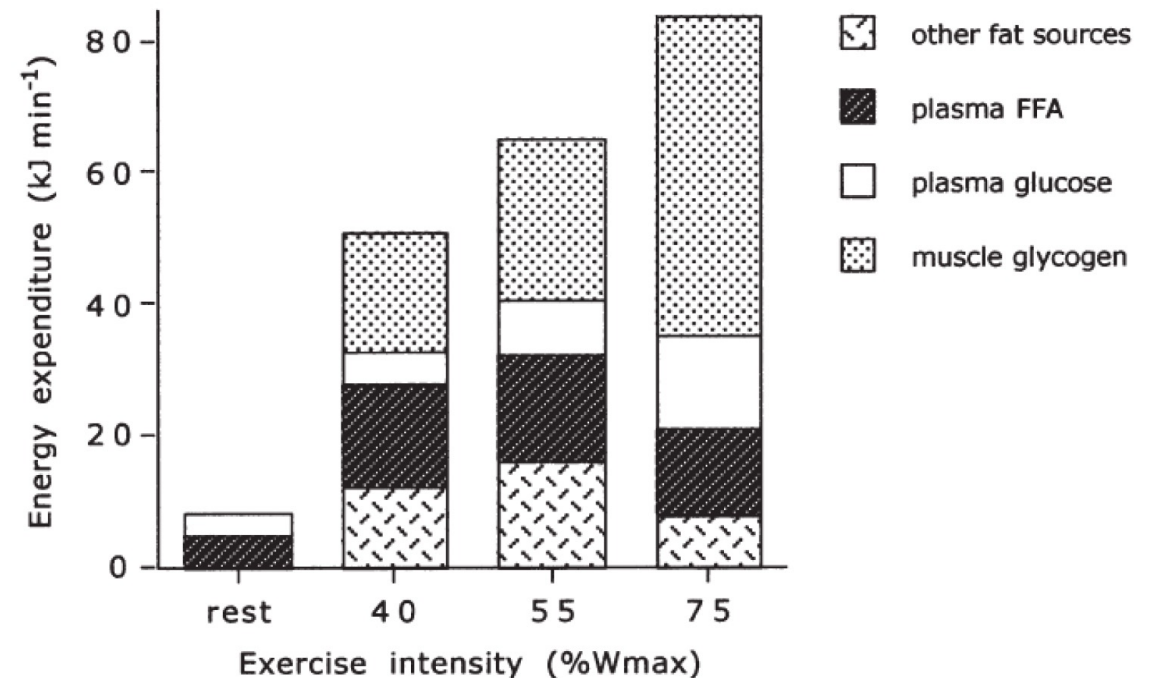
~~Protein intake~~

~~Vitamin D intake~~

~~Calcium~~

Carbohydrate and elite endurance performance

- Endurance events > 30 min
- Fastest speed/ power wins
- High percentage of $VO_{2\max}$
- Highly adapted metabolism to maximise utilization of all substrates





What is a low carbohydrate diet?

- **High CHO**

Consistently maintaining High CHO availability regardless of training demands

- **Periodised CHO**

Periodise CHO to meet the demands of training or to help drive adaptation

- **Non ketogenic low carb high fat**

Reduce carb high fat diet but doesn't lead to an increase in ketone

- **Ketogenic low carb high fat**

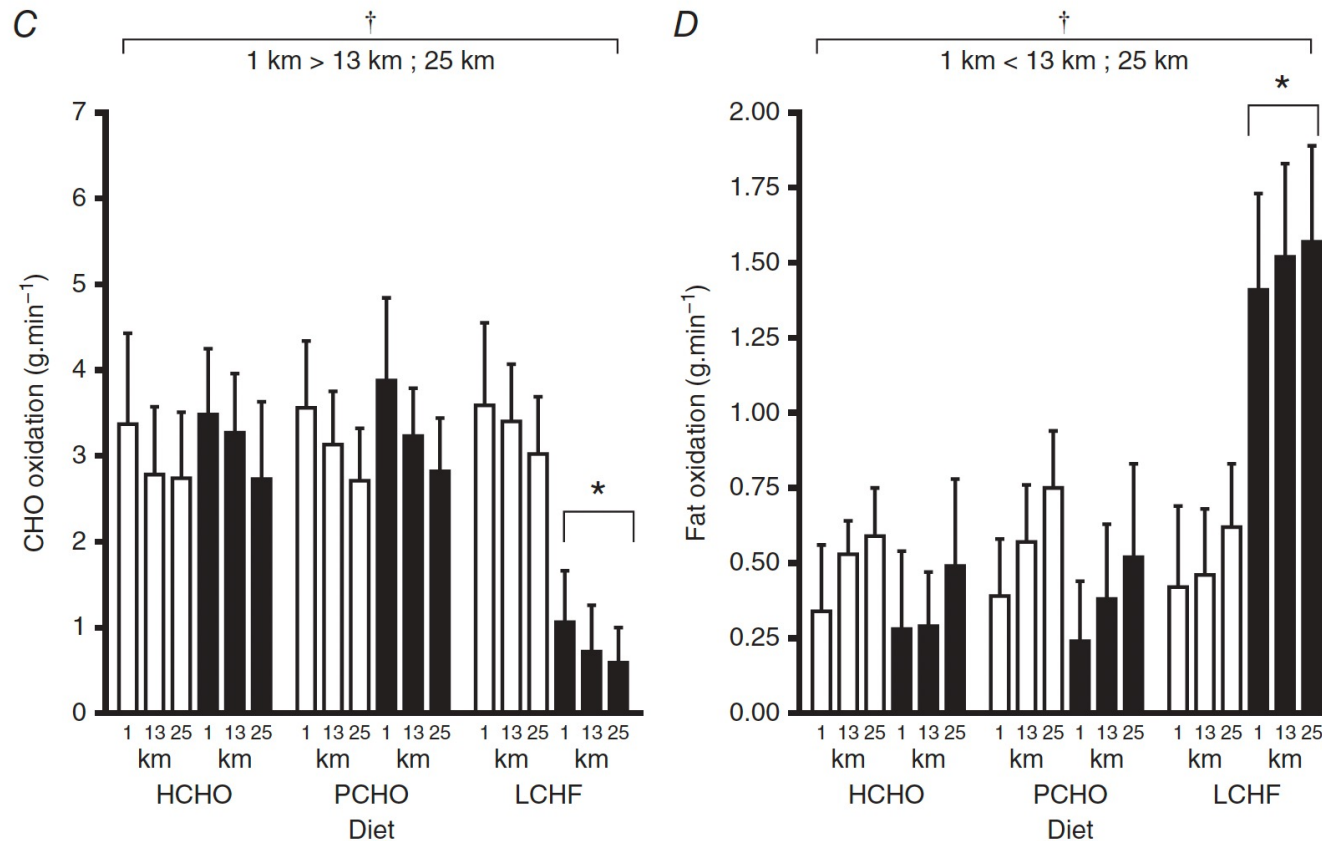
Reduce carb high fat but does induce ketosis

- **Ketogenic low carb high fat with specific high CHO training**

As above but with specific periods where high CHO availability is included

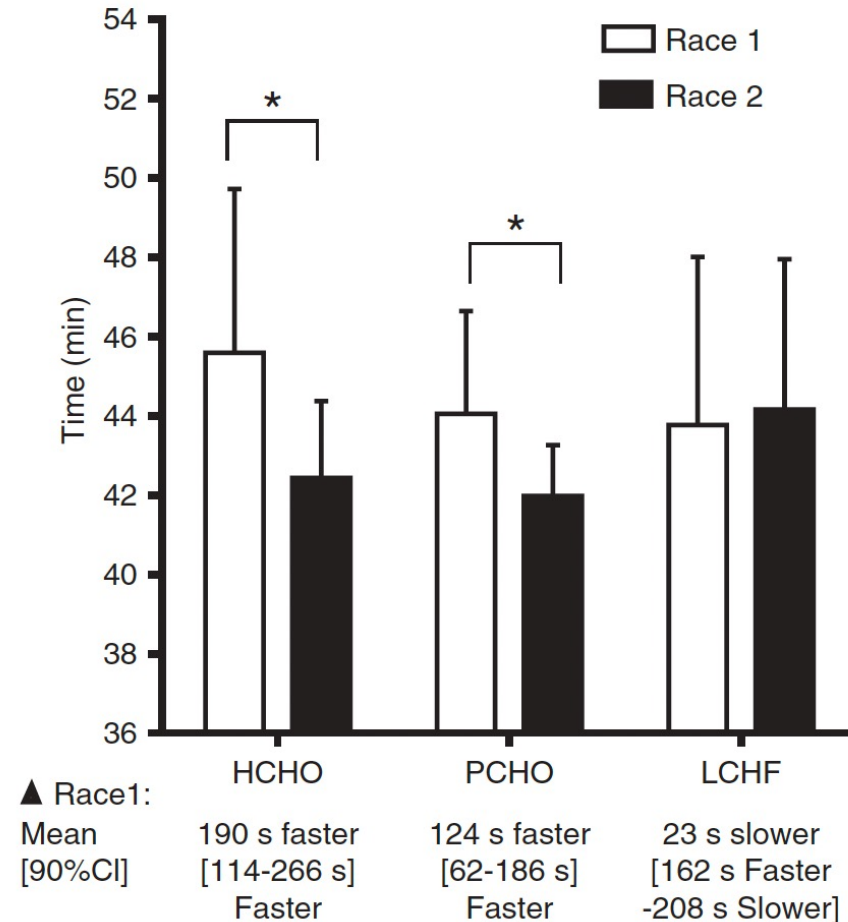
Why do athletes use low carbohydrate dietary practices? Adaptations that favor endurance phenotype

- Increase fat oxidation/ metabolism
- Reduce reliance on limited glycogen



Why do athletes use low carbohydrate dietary practices? Adaptations that favor endurance phenotype

- Does this improve performance?



Burke et al 2016

Why do athletes use low carbohydrate dietary practices? Body Composition

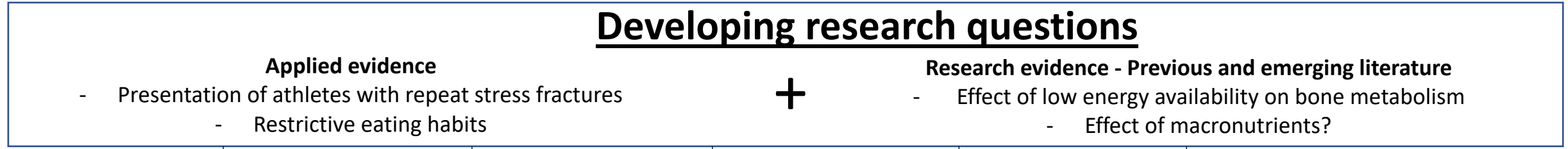
- Periodise or body composition?
- Would usually be associated with a controlled reduction in EA too
- If this is not tightly controlled and there is just an overall reduction in dietary intake it presents an issue.
- Is this happening anyway??
Inadvertent low CHO?



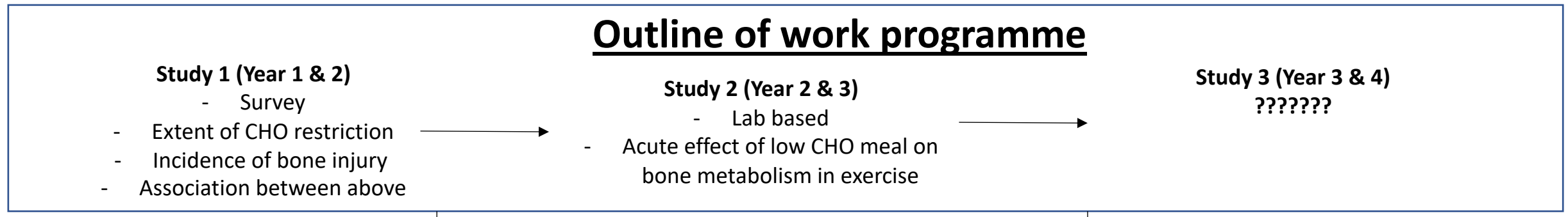


The influence of low carbohydrate dietary practices on bone in endurance athlete?

Developing research questions



Outline of work programme



Project outcomes



The influence of low carbohydrate dietary practices on bone in endurance athlete?

Developing research questions

- Applied evidence**
- Presentation of athletes with repeat stress fractures
 - Restrictive eating habits

+

- Research evidence - Previous and emerging literature**
- Effect of low energy availability on bone metabolism
 - Effect of macronutrients?

Outline of work programme

Study 1 (Year 1 & 2)

- Survey
- Extent of CHO restriction
- Incidence of bone injury
- Association between above

Study 2 (Year 2 & 3)

- Lab based
- Acute effect of low CHO meal on bone metabolism in exercise

Study 3 (Year 3 & 4)

??????????

Project outcomes

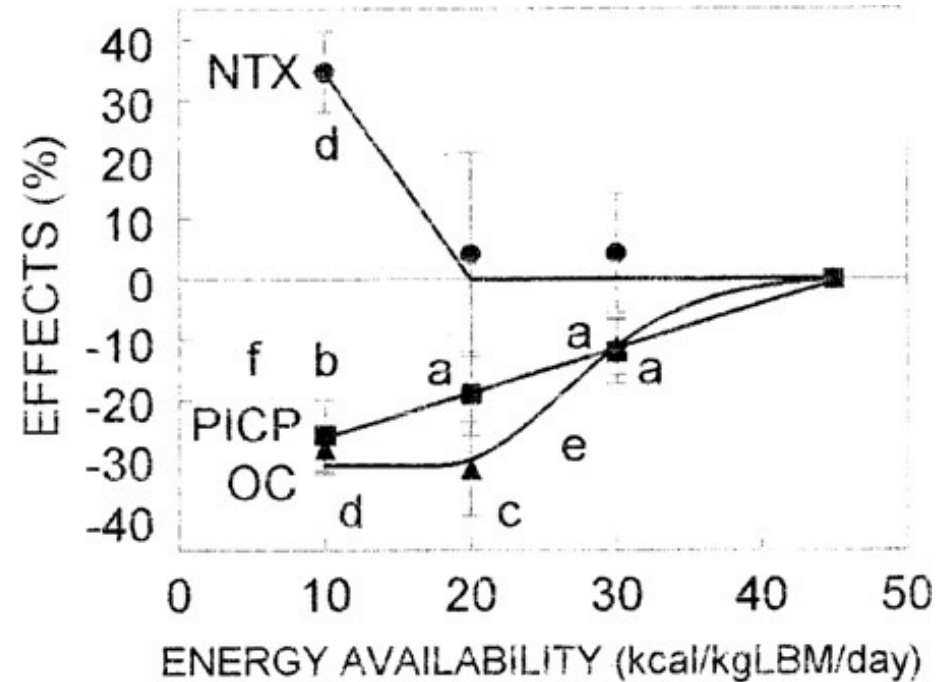
Research outcome

- Evidence to add to emerging body of work

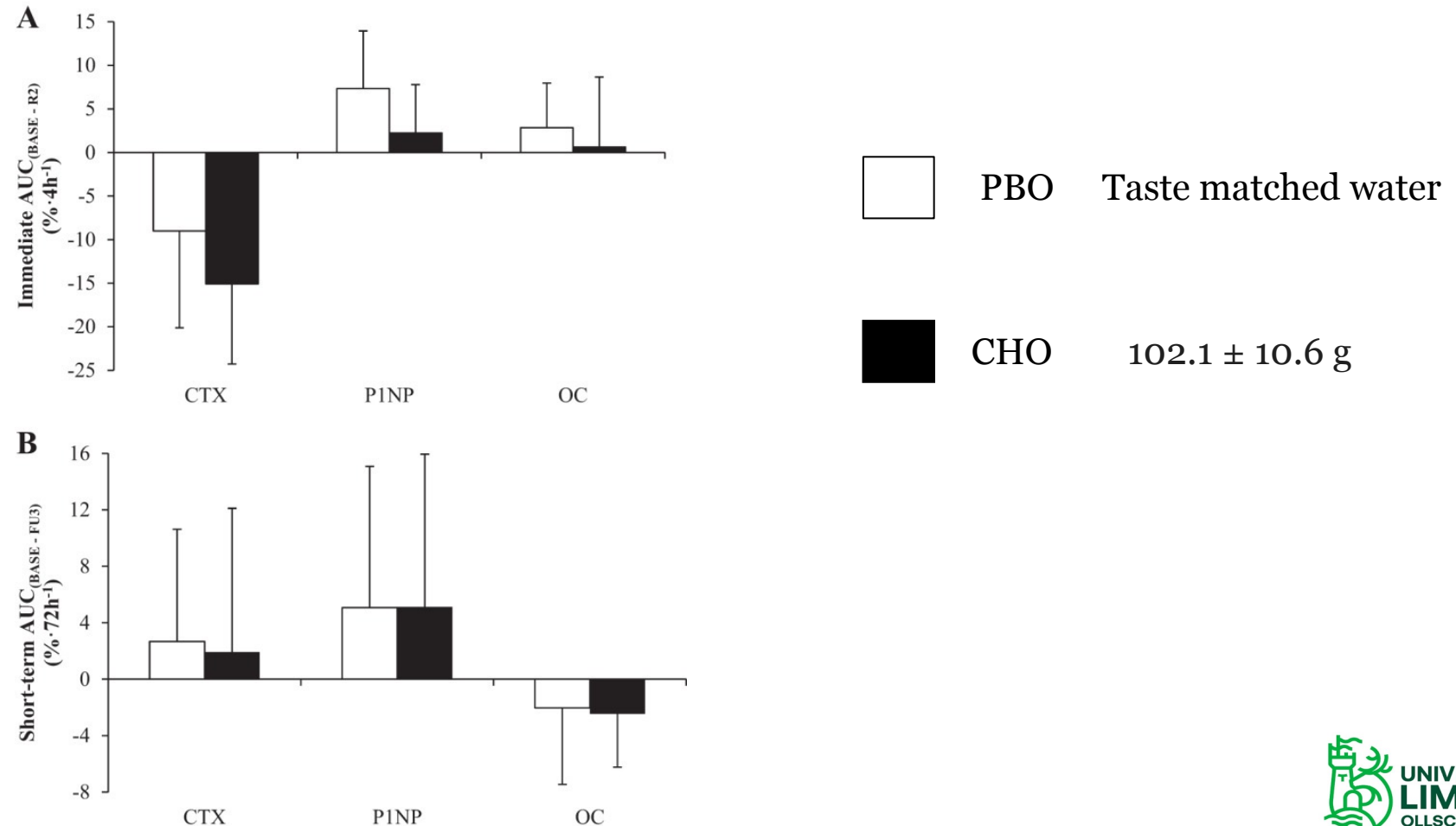
Applied outcome

- Evidence to inform practitioners

Reductions in EA lead to uncoupling of bone metabolism Ihle & Loucks 2004

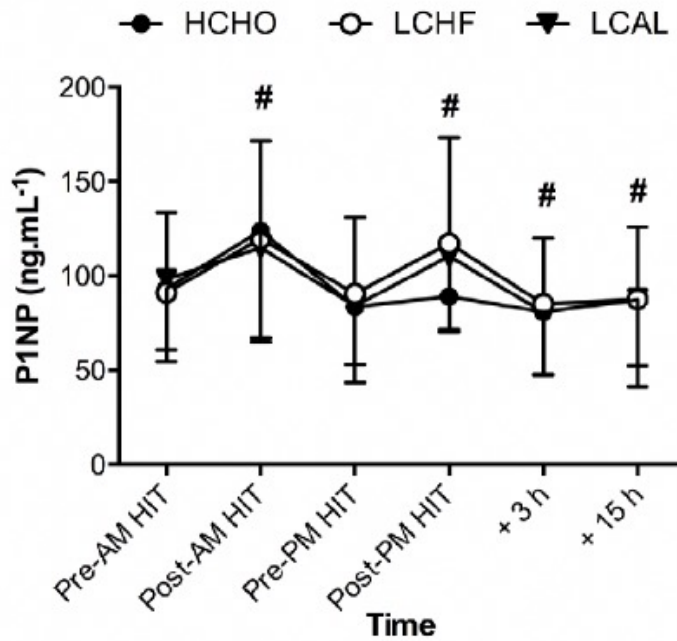


CHO feeding during 2 hours running attenuates immediate CTX response Sale et al. 2015

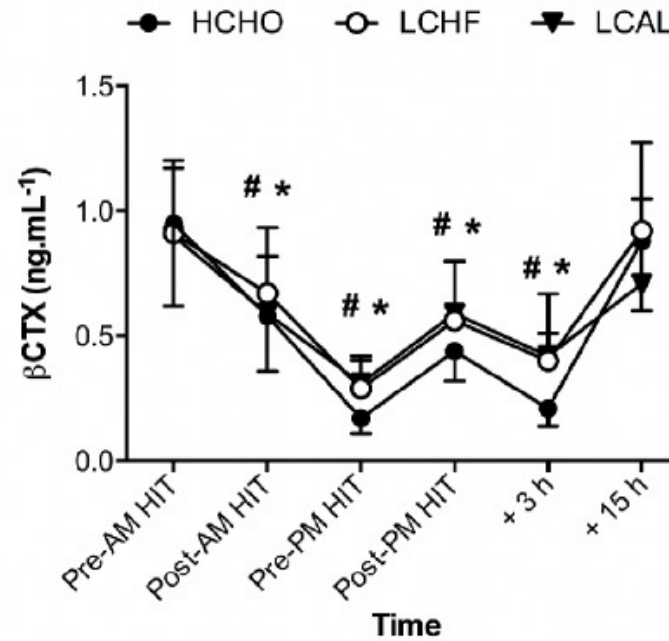


CHO before, during and after an acute training session attenuated markers of bone resorption, without influencing bone formation, an effect that was independent of energy availability (Hammond et al 2020)

(A)

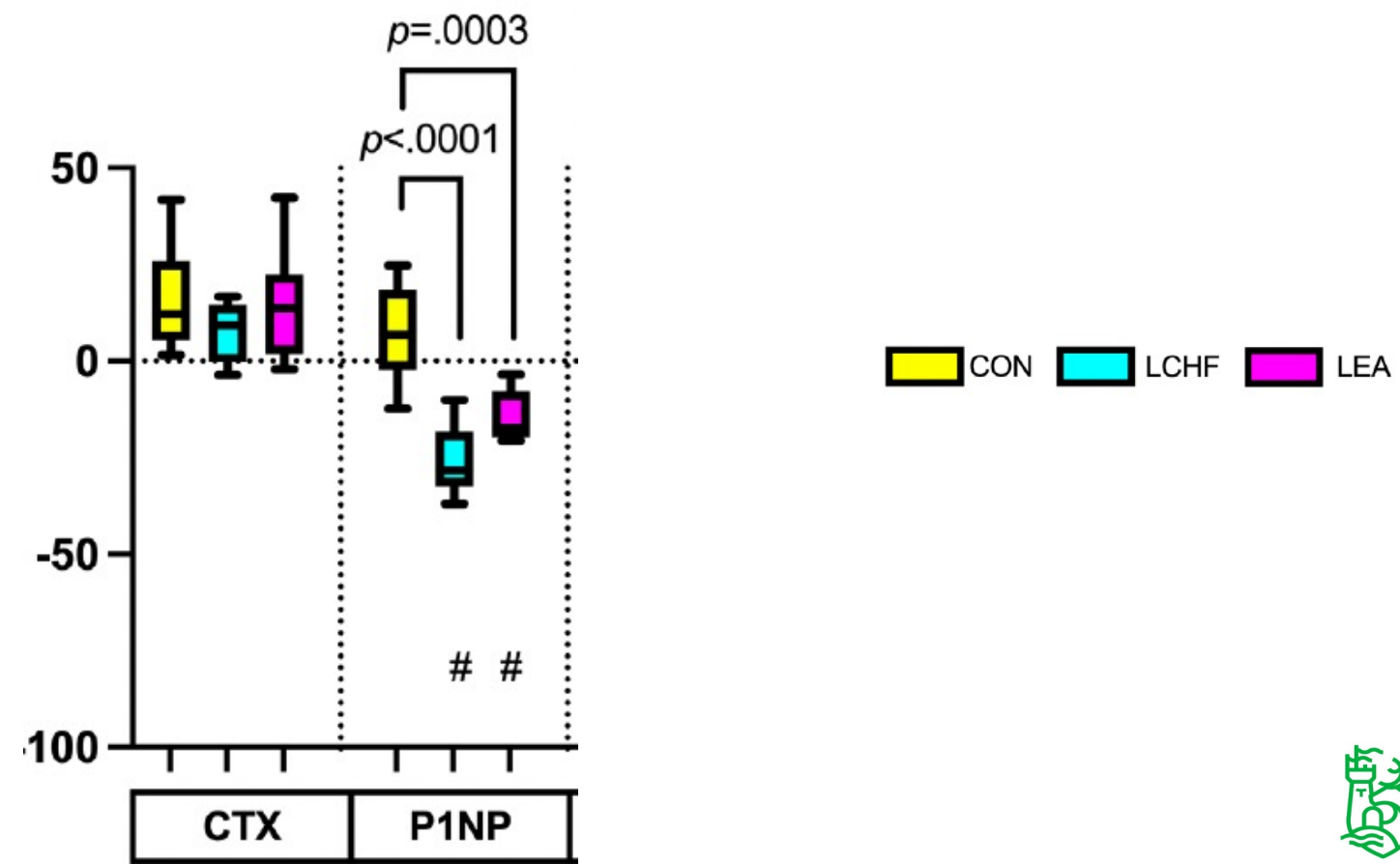


(B)





Adaptation to a short-term low carbohydrate diet reduces baseline markers of bone formation (Fensham et al 2022)





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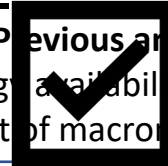
Applied evidence

- Presentation of athletes with repeat bone injury
- Restrictive eating habits

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Research evidence - Previous and emerging literature

- Effect of low energy availability on bone metabolism
- Effect of macronutrients?



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Applied evidence

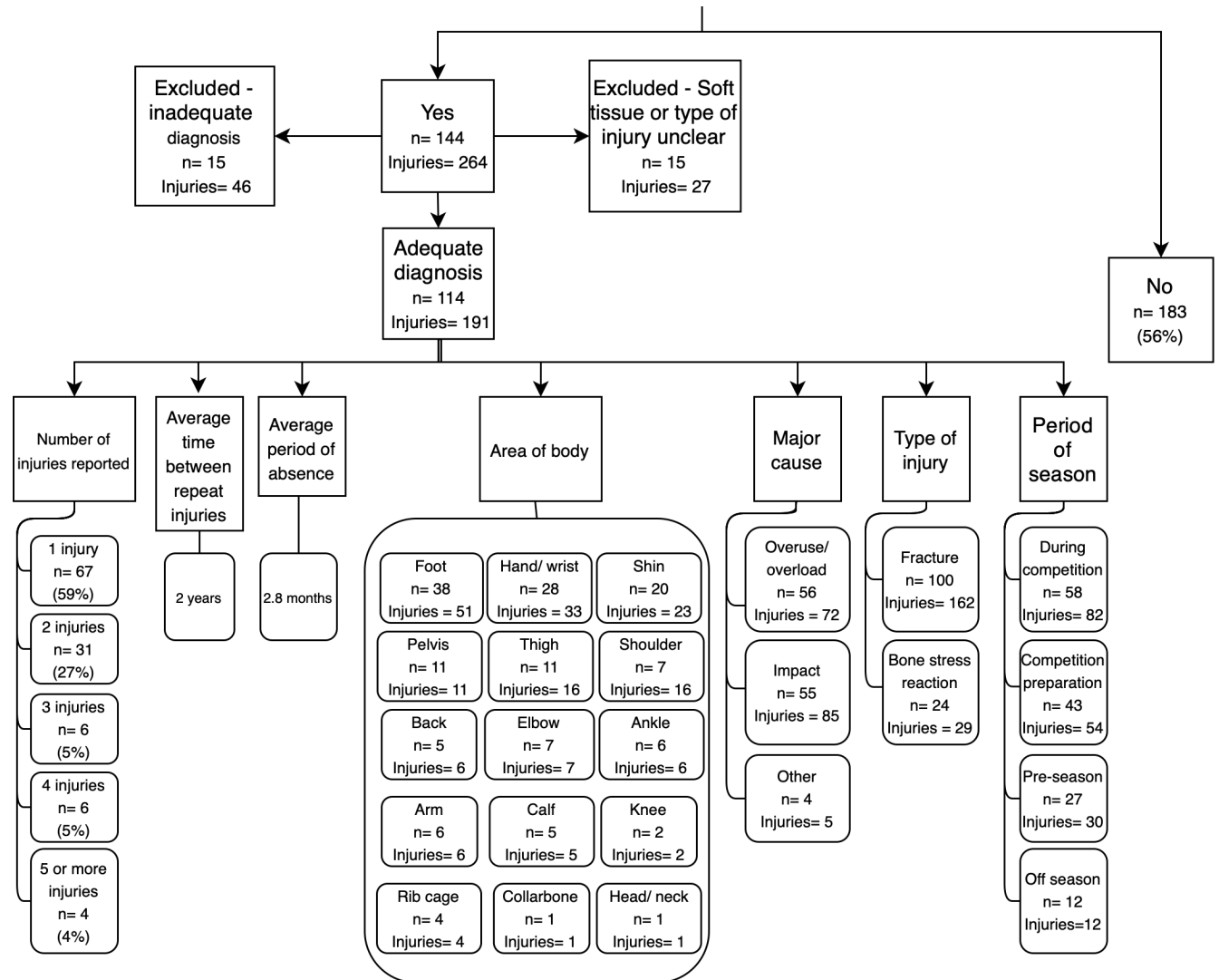
- Survey of 327 elite endurance athletes

“In your career have you ever had absences from training or competition due to a bone injury?”

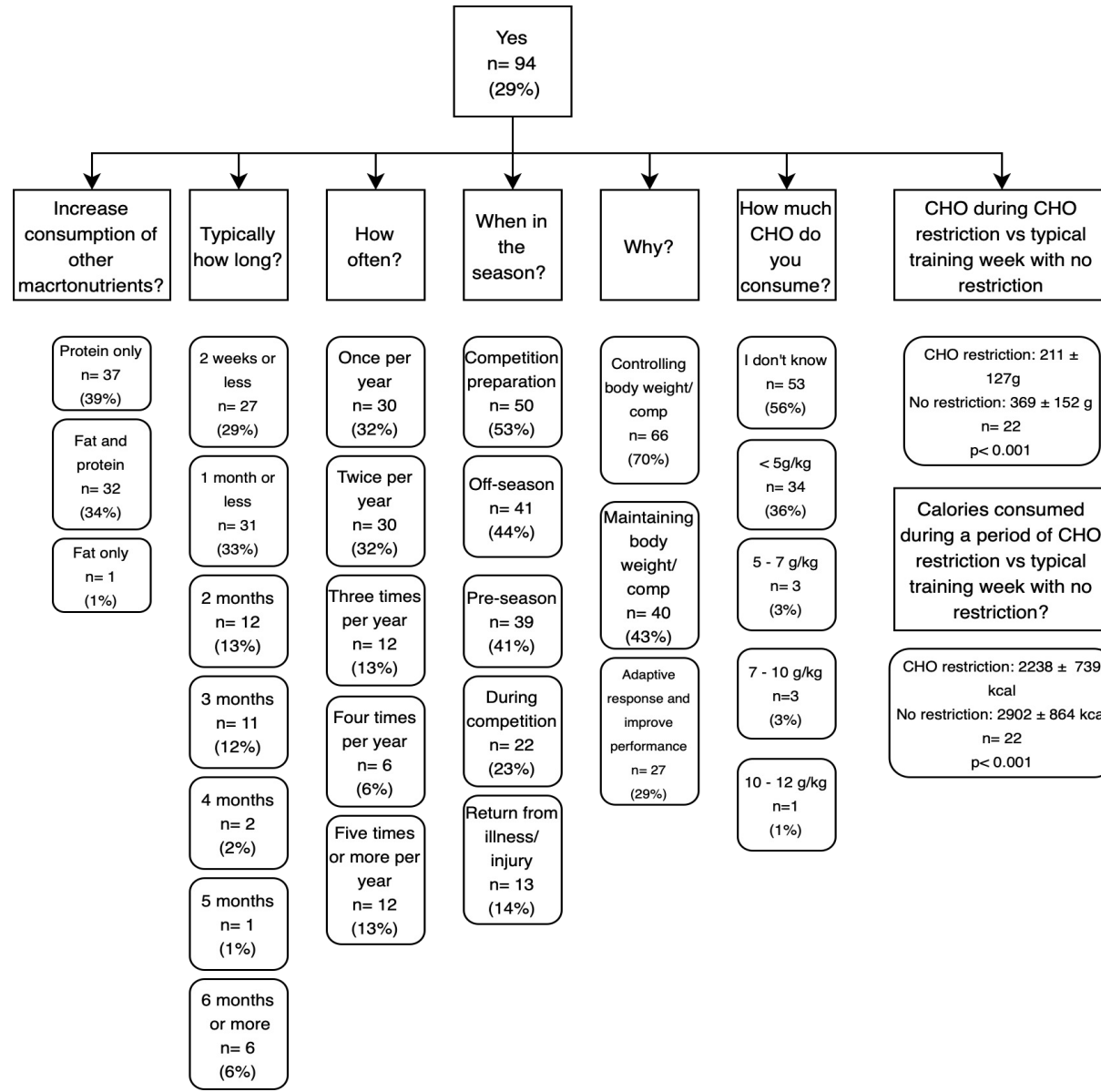
“Do you intentionally reduce CHO intake for a period of weeks to months during the season?”

“Do you train in a fasted state at any point during the season?”

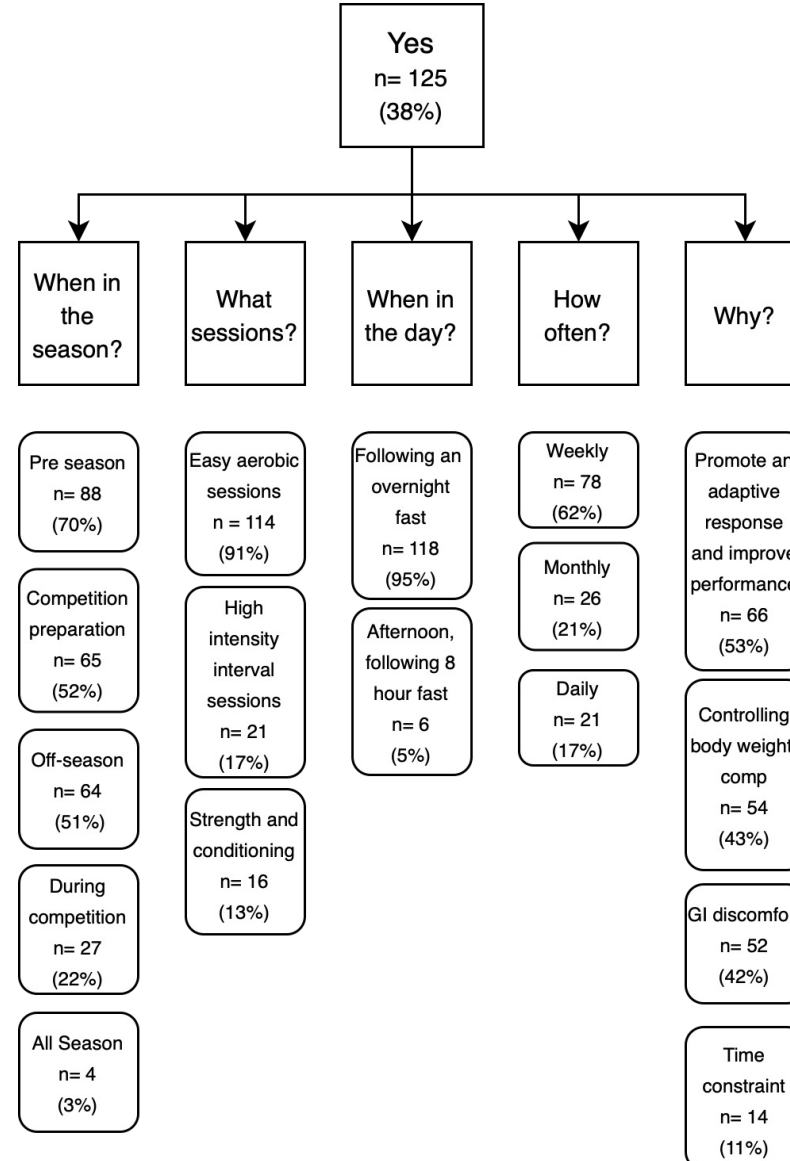
In your career have you ever had absences from training or competition due to a bone injury?



Do you intentionally reduce CHO intake for a period of weeks to months during the season?



Do you train in a fasted state at any point during the season?"



Association between dietary practice and bone injury incidence

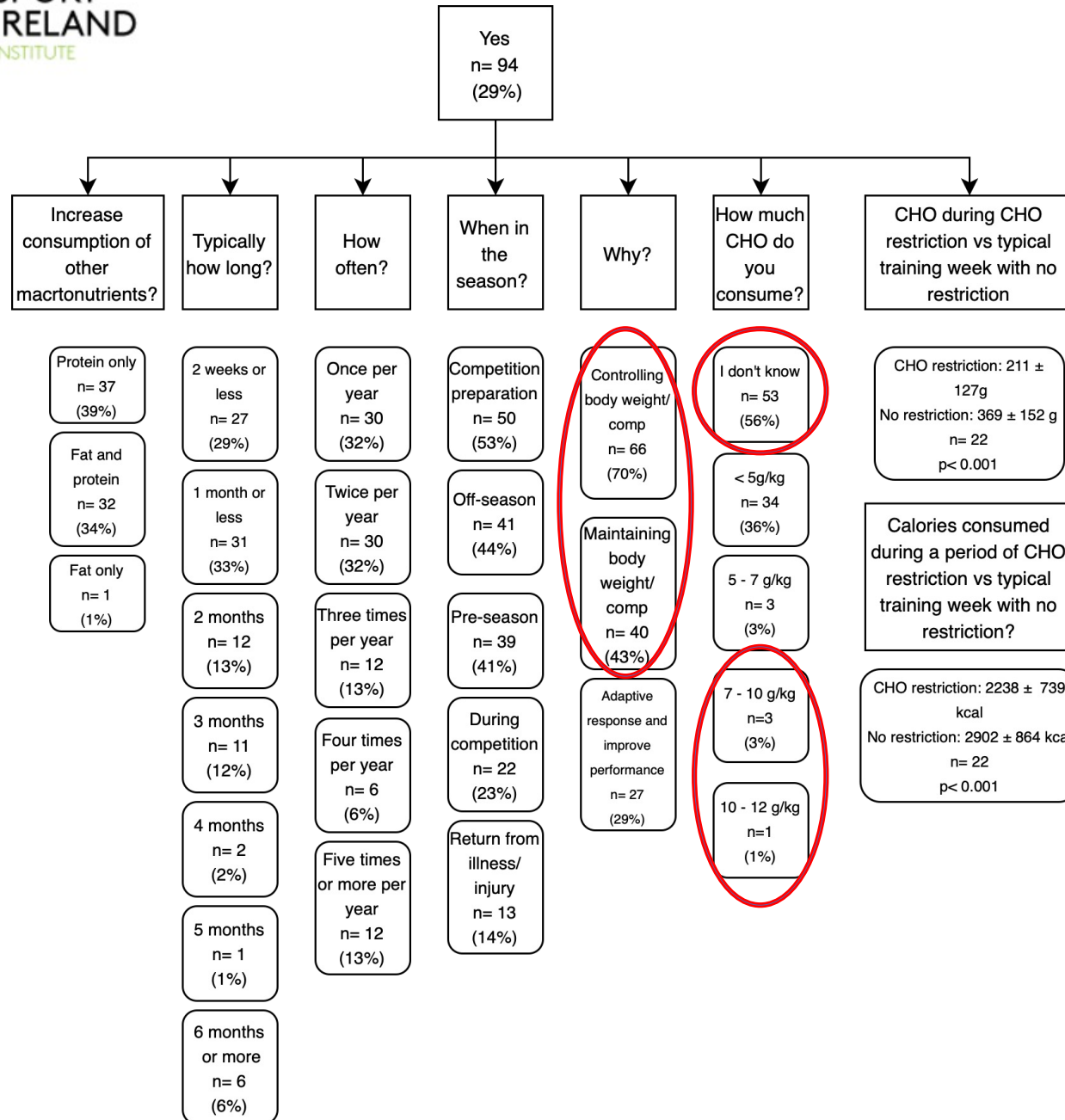
Regression model using predictors listed below to determine bone injury incidence

Strong associations

- Sex
- Diagnosed condition that influences bone health or performance
- Years of dedicated training
- Use of fasted training

Weak associations

- Athlete level
- Sport
- Weekly training volume
- The use of periods of reduced CHO intake



- Most prominent reason is not promoting an adaptive response/ driving endurance phenotype – Body comp
- Are they actually reducing CHO intake?

Summary so far

- Incidence of bone injury is high
- Restrictive or dietary practices that lead to a reduction in EA or CA may be having an impact
- Difficult to determine using self reported data. Athlete awareness of CHO intake?
- Periodizing CHO may have benefit to the endurance phenotype but only if the athlete knows how much they are eating
- 2 key questions going forward
 1. The acute effect of feeding on bone metabolism?
 2. Improving athlete awareness/ education on the use of CHO to improve performance?

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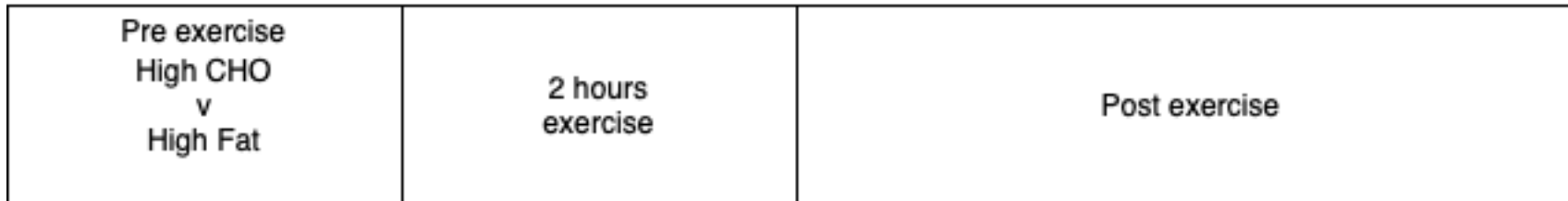
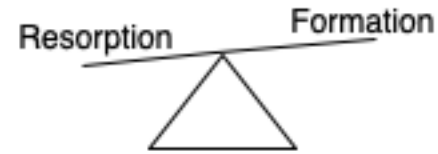
Research outcome

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Applied outcome

- Evidence to inform practitioners

The acute effect of a pre-exercise meal on the bone metabolic response to a bout of exercise

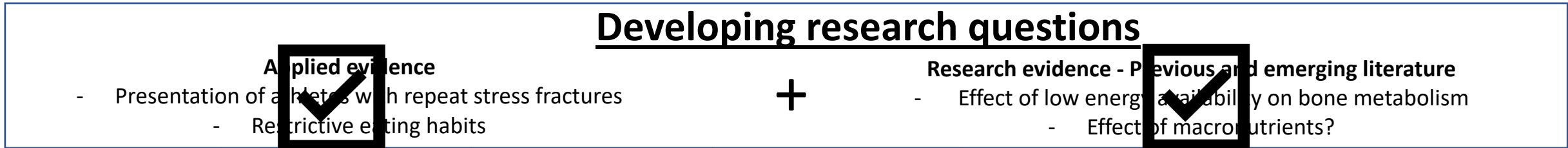


- N of 4
- Preliminary data interesting
- May be potentially seeing an effect
- Possible drivers??
- IL-6?
- Cortisol?
- Enteric or appetite hormones?

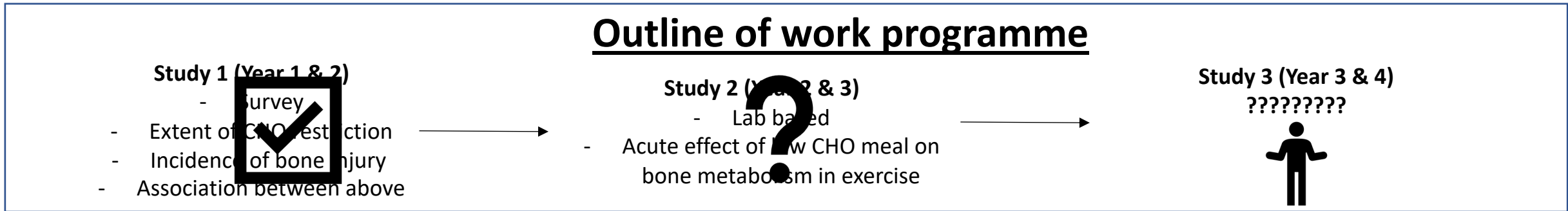


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Big issue to address – Athlete awareness of CHO intake and requirements

- There may be some value in periodizing or reducing CHO intake at certain periods of the season for reasons previously mentioned
- This requires accurate and reliable knowledge and awareness of dietary requirements and a tailored approach to ensure athletes are reducing the risk of injury/ illness
- If over 50% of athletes are reducing CHO intake but they don't know by how much, then this presents an issue.



Elon Musk ✓

@elonmusk



Finally, the truth that carbs are amazing can be said on this platform!

[#FreeSpeech](#)

6:35 PM · Oct 29, 2022 · Twitter for iPhone