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Medicine, Nursing and Health Sciences

Impact of 24-hour low and high fermentable oligo- di- mono- saccharide polyol diets on markers of exercise-induced gastrointestinal syndrome in response to exertional-heat stress.

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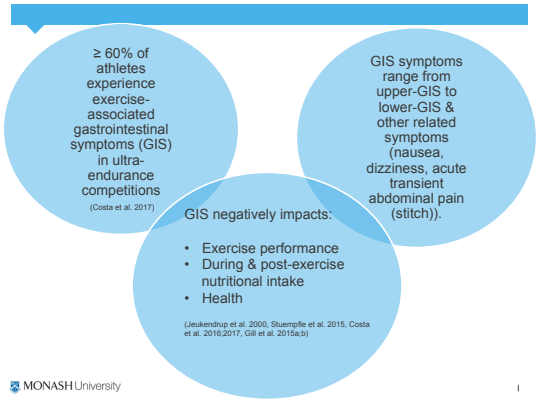

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Exercise-associated GIS

- Acute or delayed onset
- Transient nature
- Difficult to ascertain precise causal mechanism(s)

Causes

- Appear to vary in origin
- Multifactorial in nature
- Circulatory Gastrointestinal-Pathway & Neuroendocrine-Gastrointestinal Pathway

Therefore it is challenging to identify effective preventative or management strategies

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Gastrointestinal Symptoms & Diet in Endurance Athletes

- Same lower GIS experienced by individuals with functional gastrointestinal disorders
- Consumption of high carbohydrate volumes
- Dietary FODMAP intake: 80g/d in multi-sport athlete (Lis et al. 2016)
- Western intake ~25g/d (Barrett & Gibson 2010)
- n=910 athletes, >50% found to unknowingly be avoiding foods/fluids high in FODMAPs (Lis et al. 2016)
- 80% self-reported symptom improvement (Lis et al. 2016)

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FODMAPs & Exercise

Low FODMAP diet has shown efficacy in:

- reducing exercise-associated GIS in endurance runners in two case studies
- to reduce GIS in runners at rest NOT during exercise in two RCTs (Gaskell et al. 2018, Lis et al. 2016, 2018, Wiffin et al. 2019)
- Ingestion of FODMAPs before, during or after exercise risks malabsorption due to exercise-associated compromise of digestive and absorptive functions
- Consequently lower GIS may be triggered & upper GIS via ileal brake mechanism (Shin et al. 2013)

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Aim

- To determine the impact of pre- and post-exercise FODMAP intake on gastrointestinal integrity, function and symptoms in response to exertional-heat stress.

Hypothesis

- A 24-h high FODMAP diet before exertional heat stress and a high FODMAP recovery beverage will exacerbate exercise-associated gastrointestinal function and integrity markers, and result in greater GIS compared to a low FODMAP dietary intervention.
- *typical diet of endurance athletes

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Participants

Endurance trained runners	n= 10 male n= 8 female
Age (years)	35 ± 8
Weight (kg)	68 ± 12
Height (m)	1.74 ± 0.08
Body fat mass (%)	18 ± 5
VO_{2max} ($ml \cdot kg^{-1} \cdot min^{-1}$)	62 ± 9
Weekly training load (h)	10.2 ± 3.8

Study Design – Double Blind RCT

- Dietary intervention:
  - 24h prior to exercise: High (HFOD) or low (LFOD) FODMAP diet
  - Pre-exercise HFOD or LFOD b/fast, 2h prior to exercise
  - During exercise: Water consumed *ad libitum*
  - Post-exercise: HFOD or LFOD recovery beverage
- Exercise:
  - 2h treadmill running (60% VO_{2max}, 35°C, 23% RH, airflow ~10.5km·h^{-1})
- Measures:
  - Change in nude body mass pre/post exercise
  - GIS & Breath H_2 before, every 15min during & 4h post-exercise
  - RPE, TC, Rectal temperature, HR, every 15min during exercise
  - Cortisol, I-FABP, LBP, sCD4 pre-post exercise

High (HFOD) and low (LFOD) prescriptive dietary control

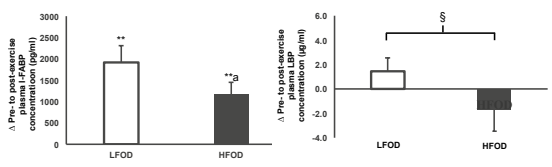
	High FODMAPs	Low FODMAPs
Breakfast	HFOD porridge: Rolled oats, quinoa flakes, raisins, dried apricots, prunes, fructose powder, vanilla sugar, dried apple, skim milk powder (fruit blended)	LFOD porridge: Whey powder, glucose powder, rolled oats, quinoa flakes, cranberries, walnuts, raisins (fruit blended)
Lunch	Soup (blended ingredients: onion, sweet potato, garlic, barley, leek, cauliflower, butter beans, water) + high fibre bread	Soup (blended ingredients: capsicum, zucchini, carrot, egg white, water) + LFOD bread
Dinner	Pasta sauce (blended ingredients: garlic, tomato tinned, olive oil, mushrooms, sweet potato) (lean beef mince) + pasta, wheat, HFOD	Pasta sauce (blended ingredients: tomato canned, spring onion tops, eggplant, carrot, egg white) (beef mince) + LFOD pasta
Snacks	Orange, Kiwi Fruit, Eggs, High Fibre Bread, Water	Orange, Kiwi Fruit, Eggs, LFOD Bread, Water
Pre-Exercise Breakfast	HFOD porridge	LFOD porridge
Post-exercise Recovery Shake	Blended skim milk powder, fructose powder, sugar, chocolate drinking powder, mannitol powder, inulin, lupin with water	Blended whey protein isolate, chocolate drinking powder, sugar with water

Table 1. Nutrient Composition of 24-h high and low FODMAP diet

	High FODMAP	Low FODMAP	P value
Energy (kcal)	2730 ± 767	2502 ± 581	0.071
Protein (g)	103 ± 29	91 ± 23	0.014*
Fat (g)	68 ± 18	66 ± 15	0.448
Total Carbohydrate (g)	405 ± 124	355 ± 89	0.016*
Total Dietary Fibre (g)	53 ± 16	50 ± 9	0.248
Total FODMAP (g)	46.7 ± 26.2	2.0 ± 0.7	<0.001
Oligosaccharides (g)	10.8 ± 3.7	1.8 ± 0.7	<0.001
Polyols (g)	6.2 ± 2.2	0.2 ± 0.1	<0.001
Lactose (g)	21.2 ± 15.1	0.0 ± 0.1	<0.001
Excess of Fructose (g)	8.7 ± 7.2	Nil	<0.001

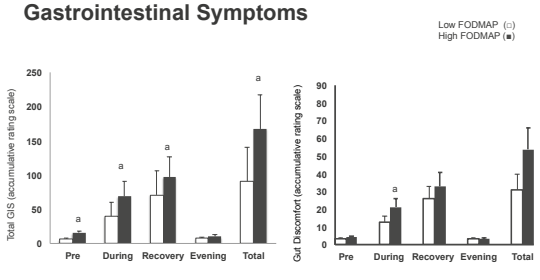
n=18; mean ± SD

Gastrointestinal Integrity Markers



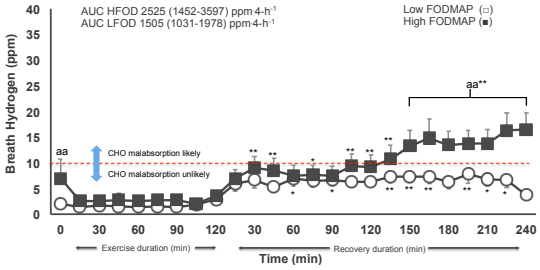
Mean ± SEM (n=15): ** P< 0.01 *vs.* pre-exercise, ª P< 0.05 *vs.* LFOD, and § P= 0.088 *vs.* LFOD.

Gastrointestinal Symptoms



Mean ± SEM (n=17): ª P< 0.05 *vs.* LFOD.

Breath Hydrogen Responses



Mean ± SEM (n=18): ˆˆ P< 0.01 and ˆ P< 0.05 *vs.* 0 min post-exercise, ** P< 0.01 *vs.* LFOD. Dash line represents significant rise in breath H_2 ≥10 ppm[42] (marker of carbohydrate malabsorption).

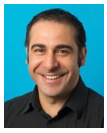
Conclusions & Implications

- A single day low FODMAP diet prior to exertional heat stress, and a low FODMAP recovery beverage immediately after exercise, reduces gastrointestinal symptoms and maintains function compared to a high FODMAP diet
- A low FODMAP diet results in substantially greater intestinal epithelial injury compared to a high FODMAP diet

Recommendations

- To reduce the risk of carbohydrate malabsorption and GIS during and post-exercise, a 24h low FODMAP diet prior to and immediately after exertional heat stress may be helpful
- Consuming carbohydrate during exertional heat stress has been shown to ameliorate epithelial injury

Thank you & Acknowledgements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