

Medicine & Science in Ultra-Endurance Sports

**NEW KNOWLEDGE FROM WSER RESEARCH:
GI SYMPTOMS DURING
ULTRAMARATHON RUNNING**

Kristin J. Stuempfle, PhD, FACSM, ATC

Gettysburg College

June 23, 2015



The Great American

“The hardest part about an ultrarun isn't the running. It's getting my stomach to cooperate.”

-Ann Trason, 14-time women's winner of WSER.



PatitucciPhoto

GI DISTRESS

- 37- 96% of runners in 161 km races
- 161 km races:
 - Non-finishers: 1st reason for dropping out
 - Finishers: 2nd issue impacting performance

GI Distress at WSER

- Characterization of symptoms
- Potential causes

bathroom? Bathroom?! BATHROOM?!?!?



WSER 2013 GI DISTRESS STUDY



PURPOSE

To examine the incidence, severity, and timing of upper and lower GI symptoms in finishers and non-finishers of a 161-km ultramarathon

POST-RACE WEB-BASED SURVEY



SurveyMonkey.com
because knowledge is everything

- All starters
- Finishers and non-finishers
- GI distress and no GI distress
- GI symptoms during WSER 2013
- Previous GI symptoms

GI SYMPTOMS

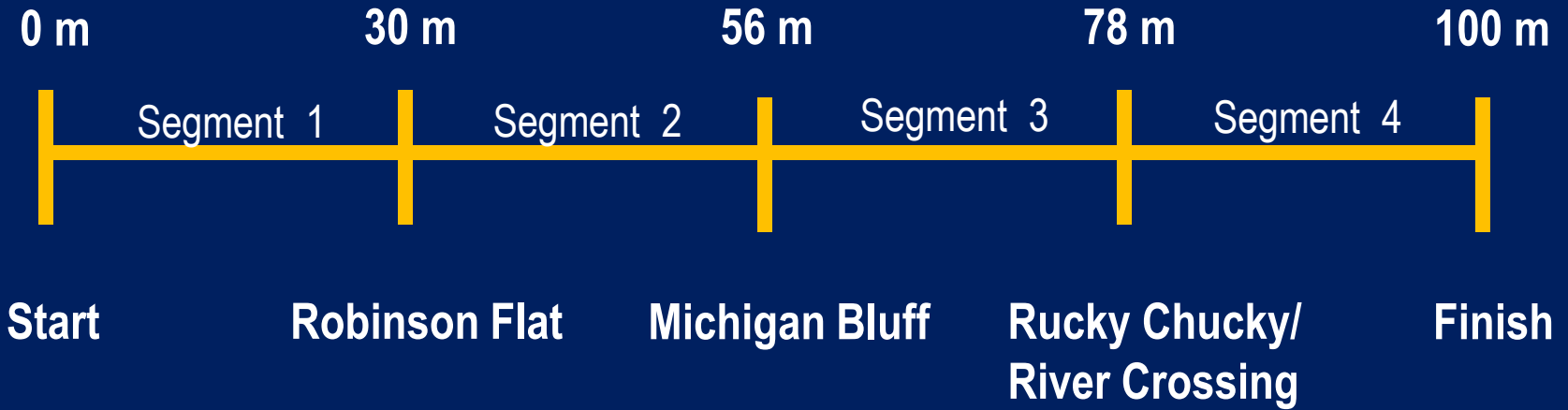
Upper GI Symptoms

- Reflux/heartburn
- Belching
- Stomach bloating
- Stomach cramps/pain
- Nausea
- Vomiting

Lower GI Symptoms

- Intestinal cramps/pain
- Flatulence
- Side ache/stitch
- Urge to defecate
- Loose stool/diarrhea
- Intestinal bleeding/bloody feces

GI SYMPTOMS BY RACE SEGMENT



GI SYMPTOM SEVERITY

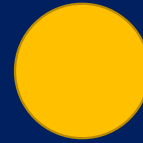
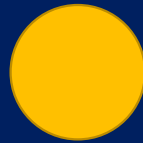
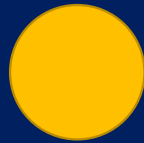
None

Mild

Moderate

Severe

Very Severe



0

1

2

3

4

BODY WEIGHT



0 m

30 m

56 m

78 m

100 m



Start

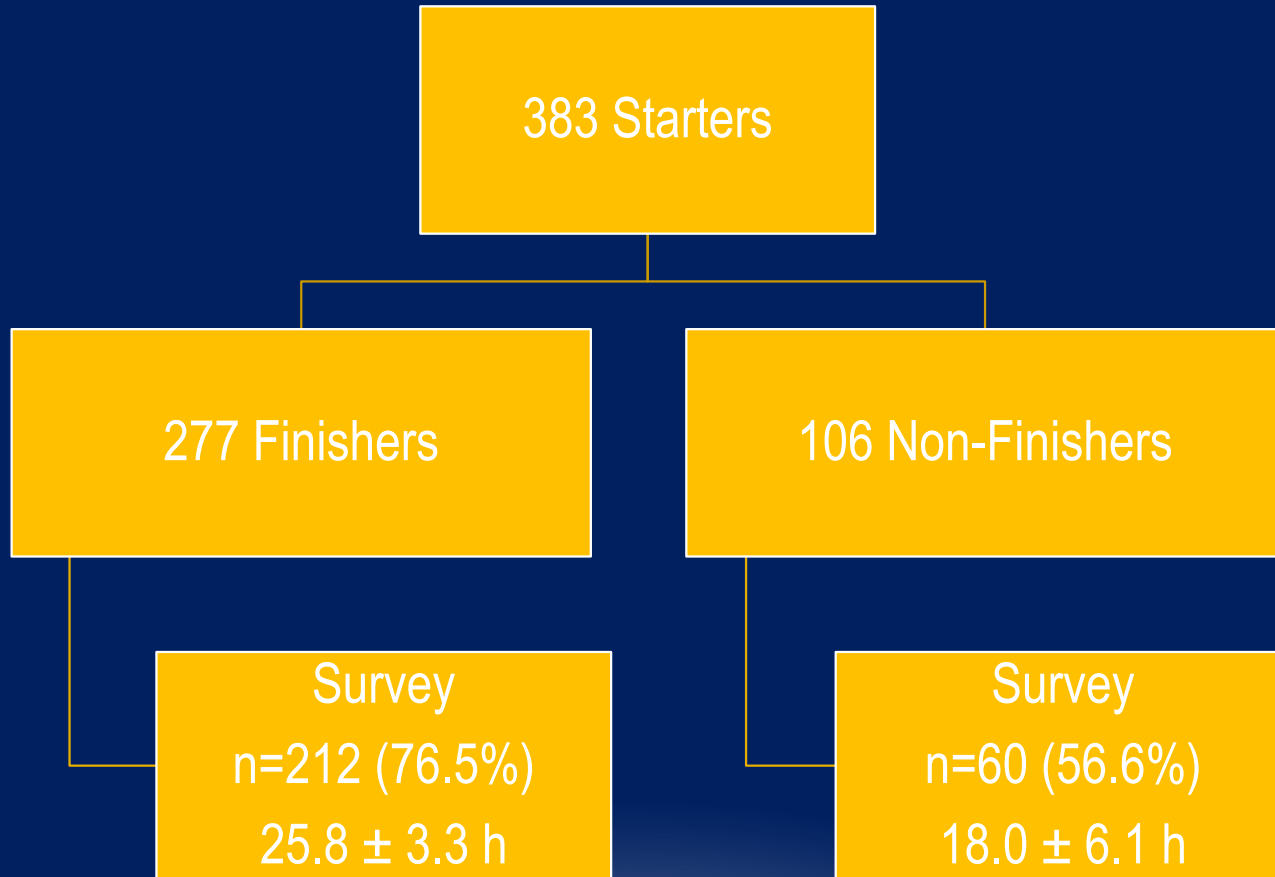
Robinson Flat

Michigan Bluff

Rucky Chucky/
River Crossing

Finish

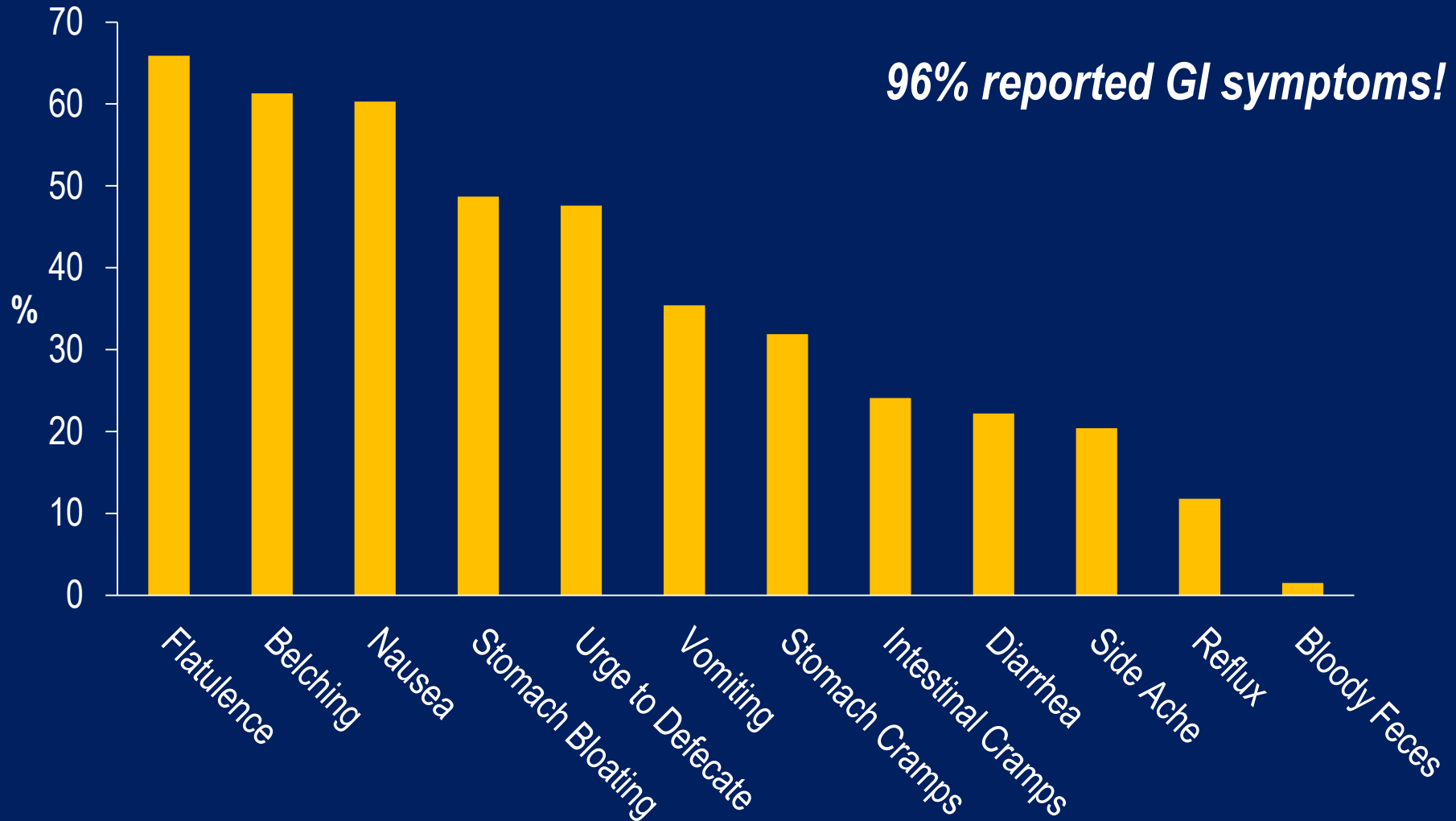
SUBJECTS



Survey
n=272

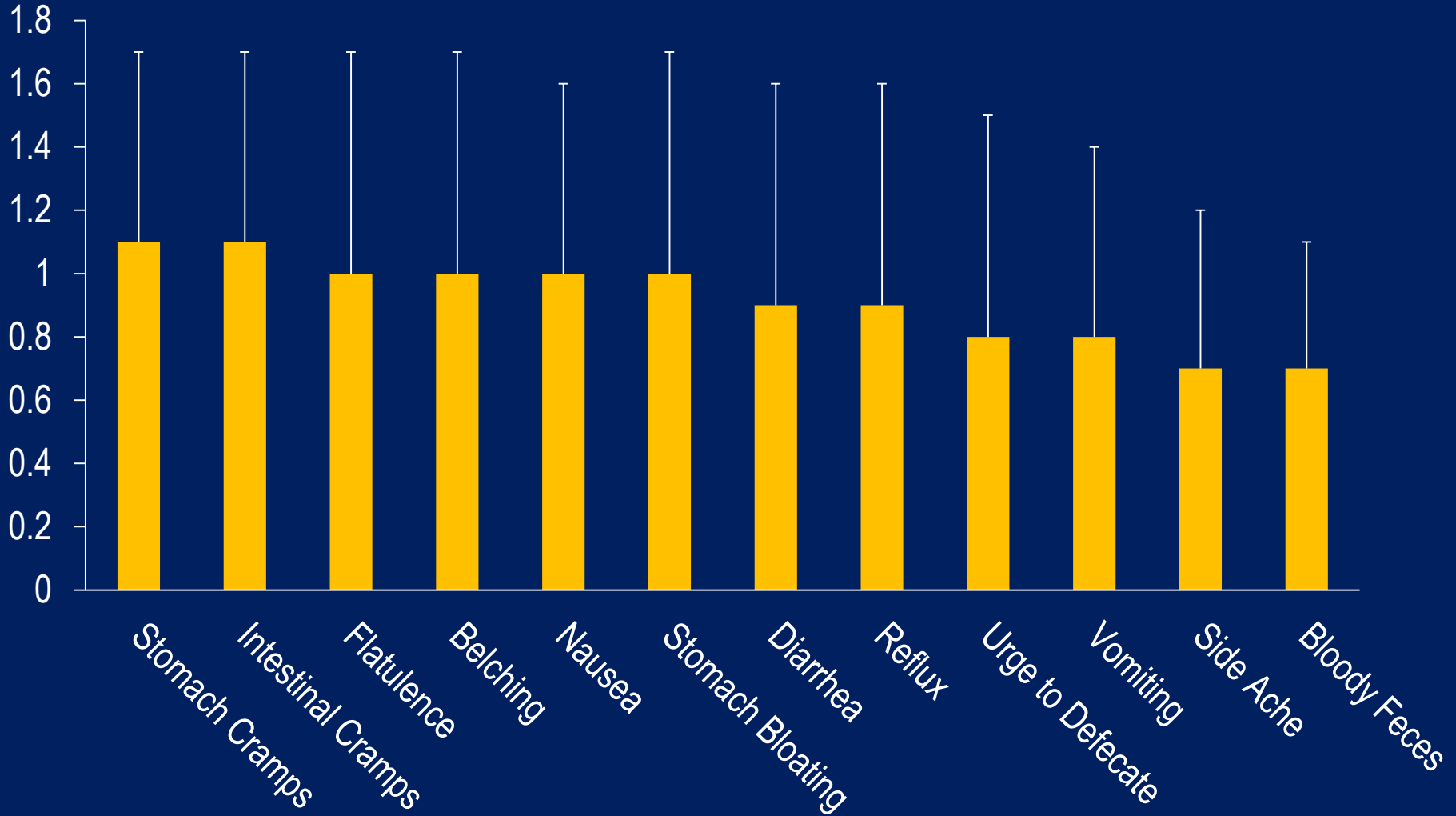
FREQUENCY OF GI SYMPTOMS

(n = 272)

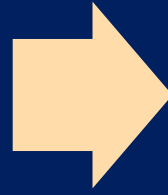


SEVERITY OF GI SYMPTOMS

(n = 272)



If



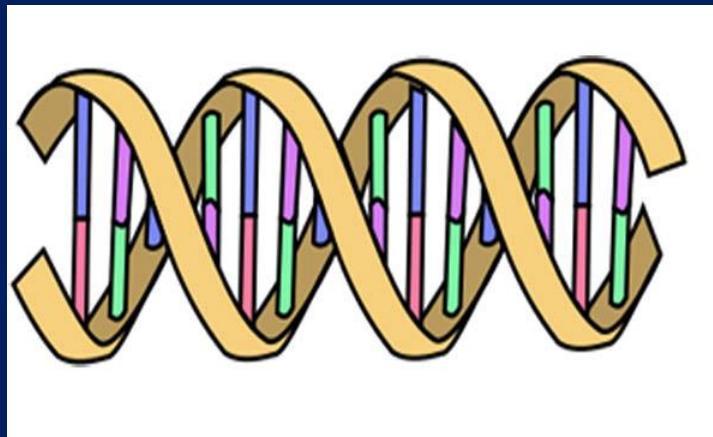
Then

- Flatulence
- Belching
- Nausea
- Stomach bloating

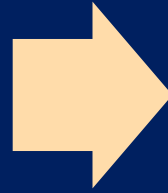
➤ *In the past while running*

- Flatulence
- Belching
- Nausea
- Stomach bloating

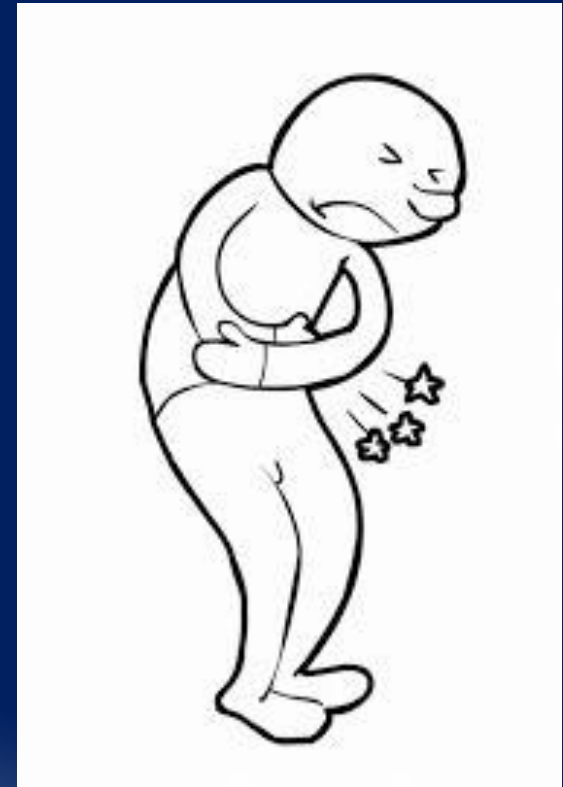
➤ *During the WSER 2013*



If

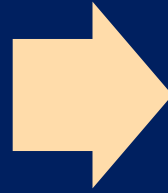


Then



Females more likely to have stomach bloating

If



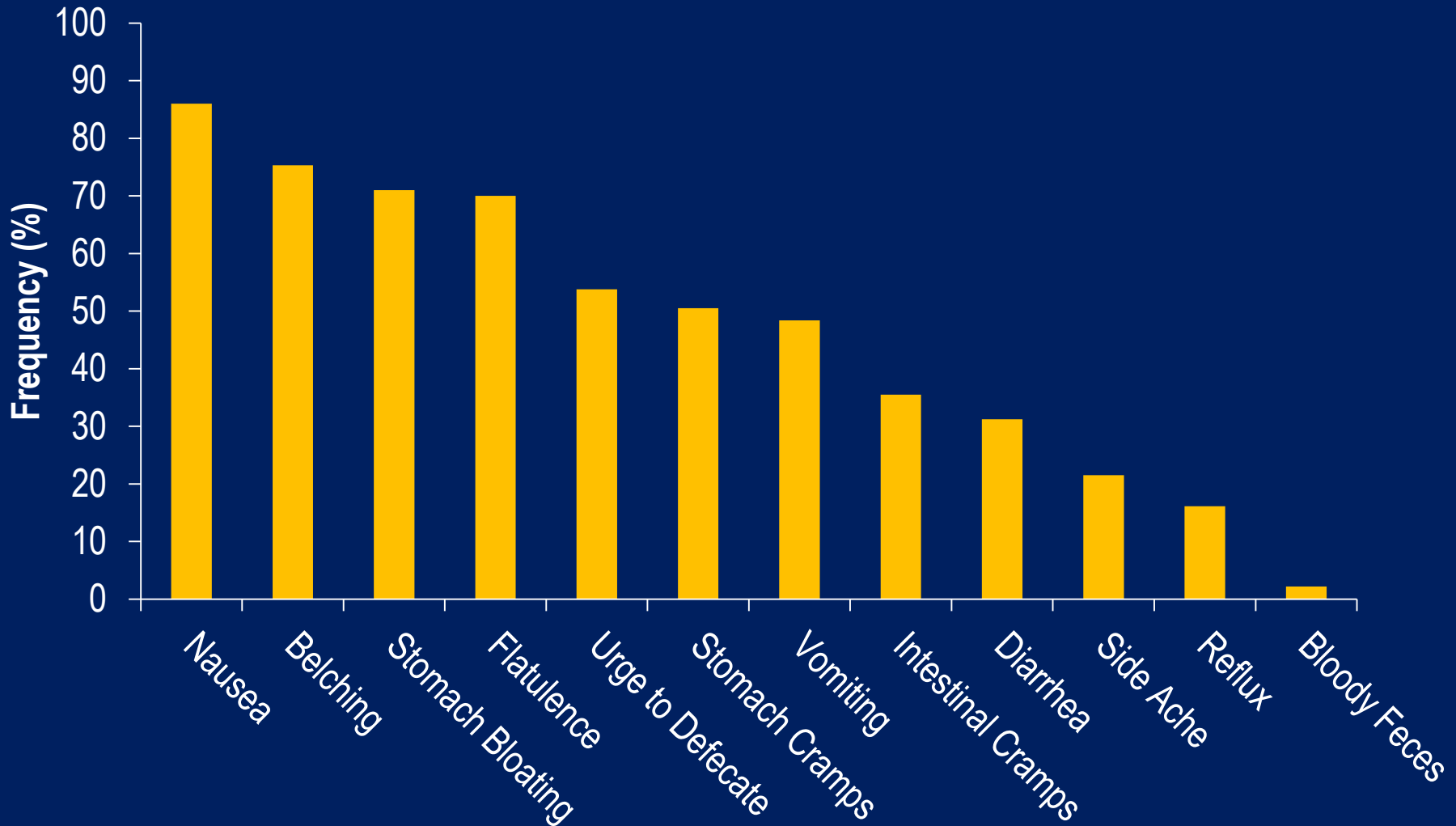
Then



Finishers more likely to experience belching

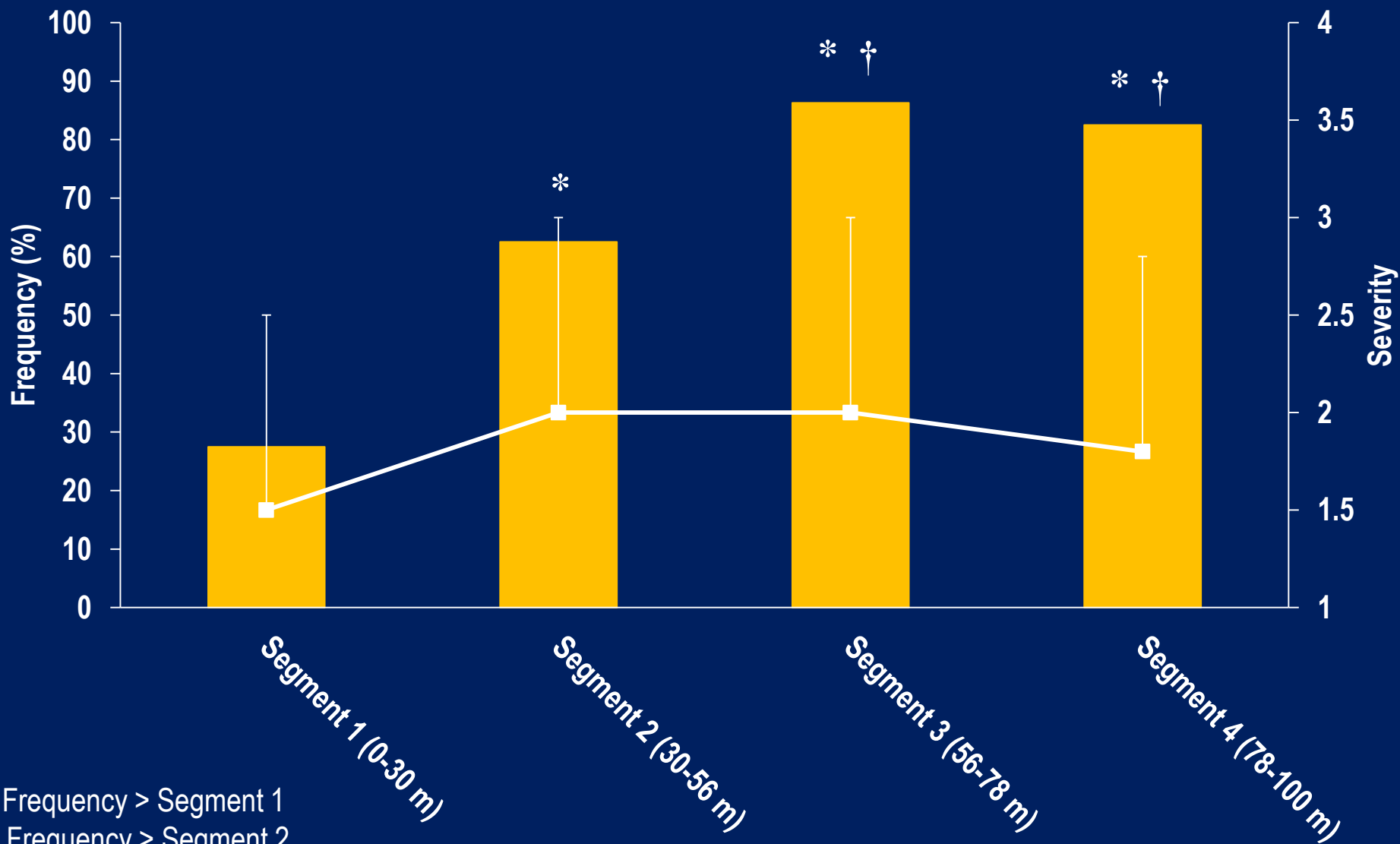
FINISHERS, GI SYMPTOMS AFFECTED PERFORMANCE

(44%; n = 93)

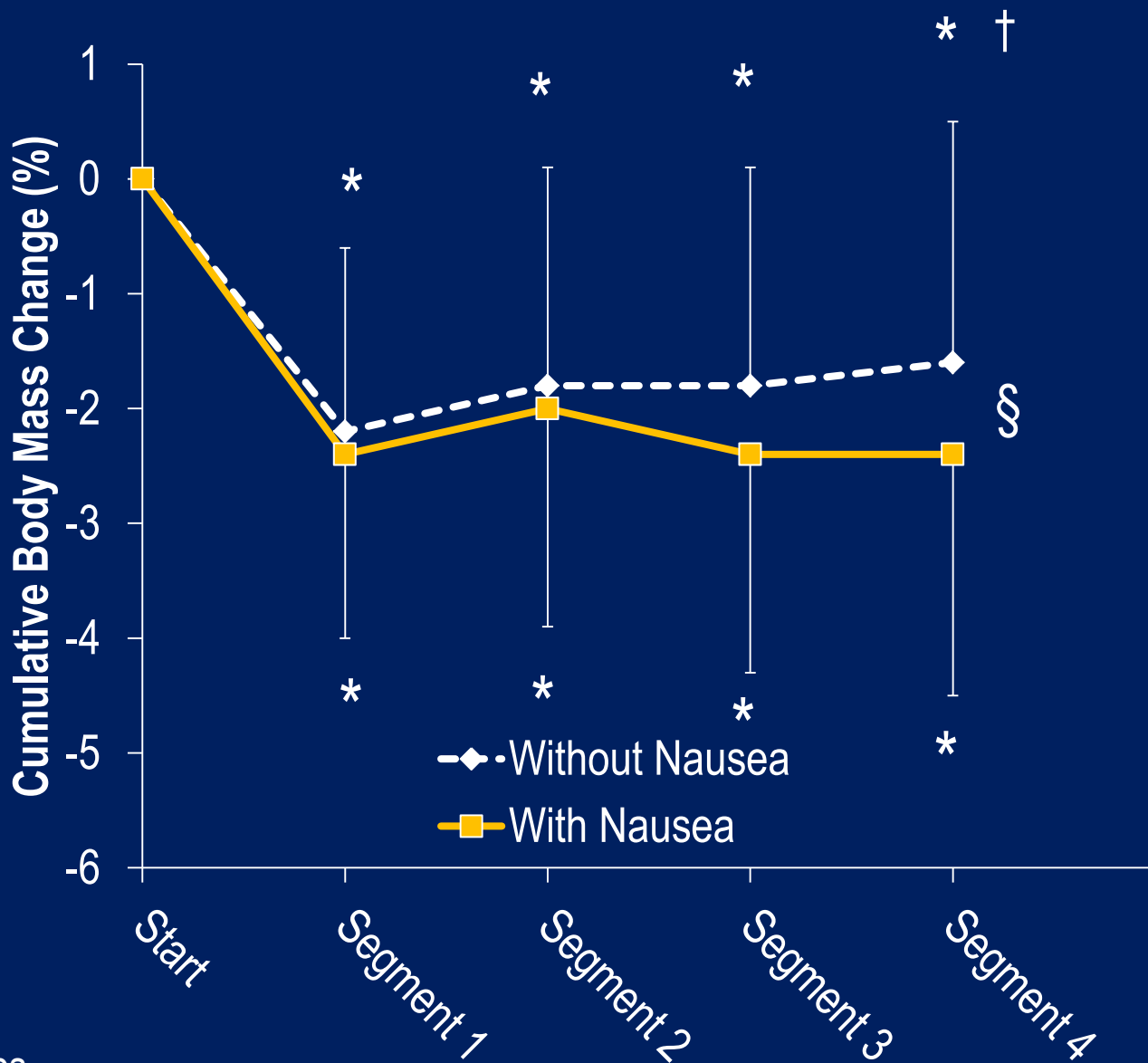


NAUSEA FREQUENCY AND SEVERITY BY SEGMENT

(n = 80)



CUMULATIVE BODY MASS CHANGE FOR FINISHERS BY NAUSEA STATUS

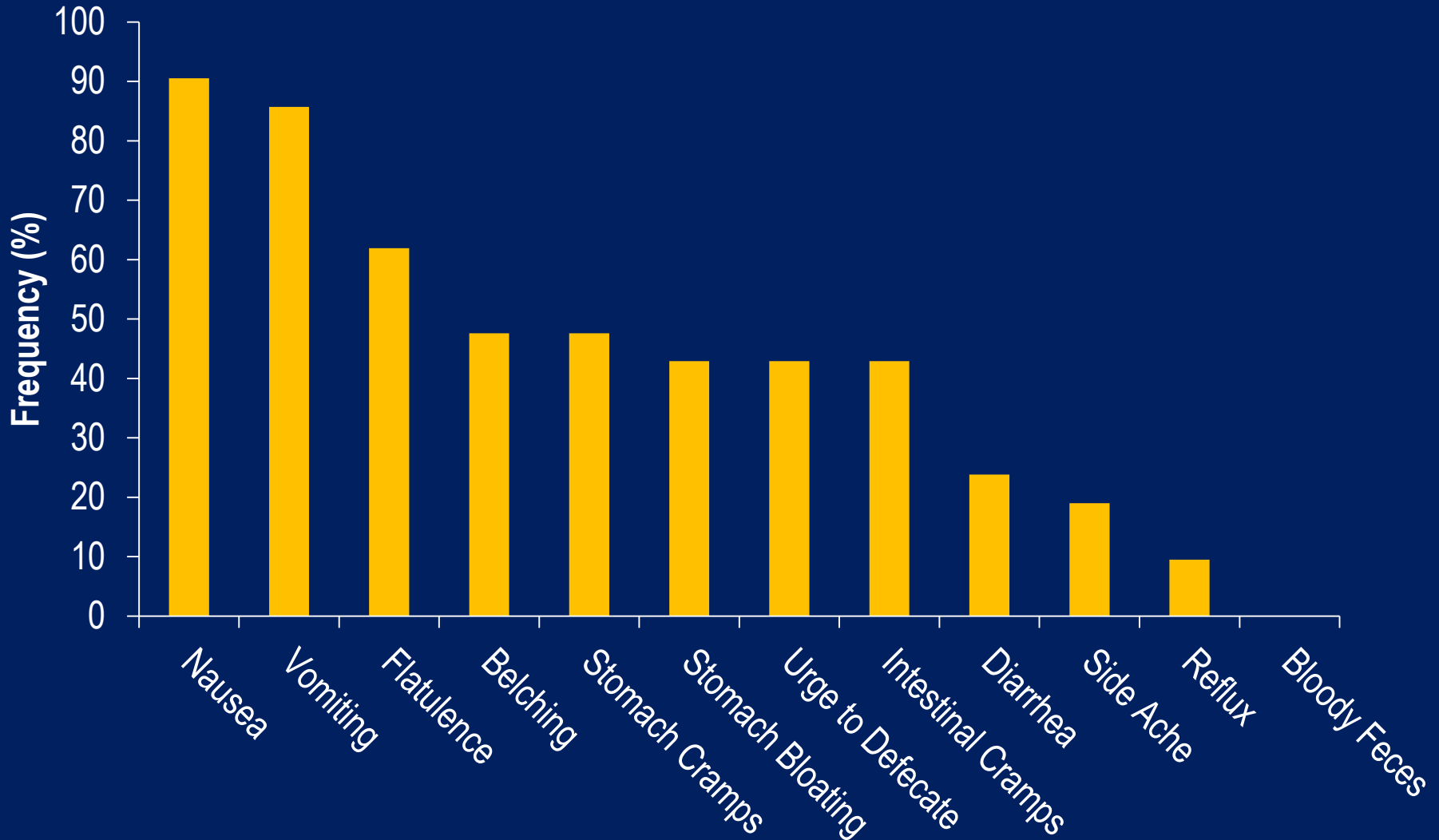


* < Start

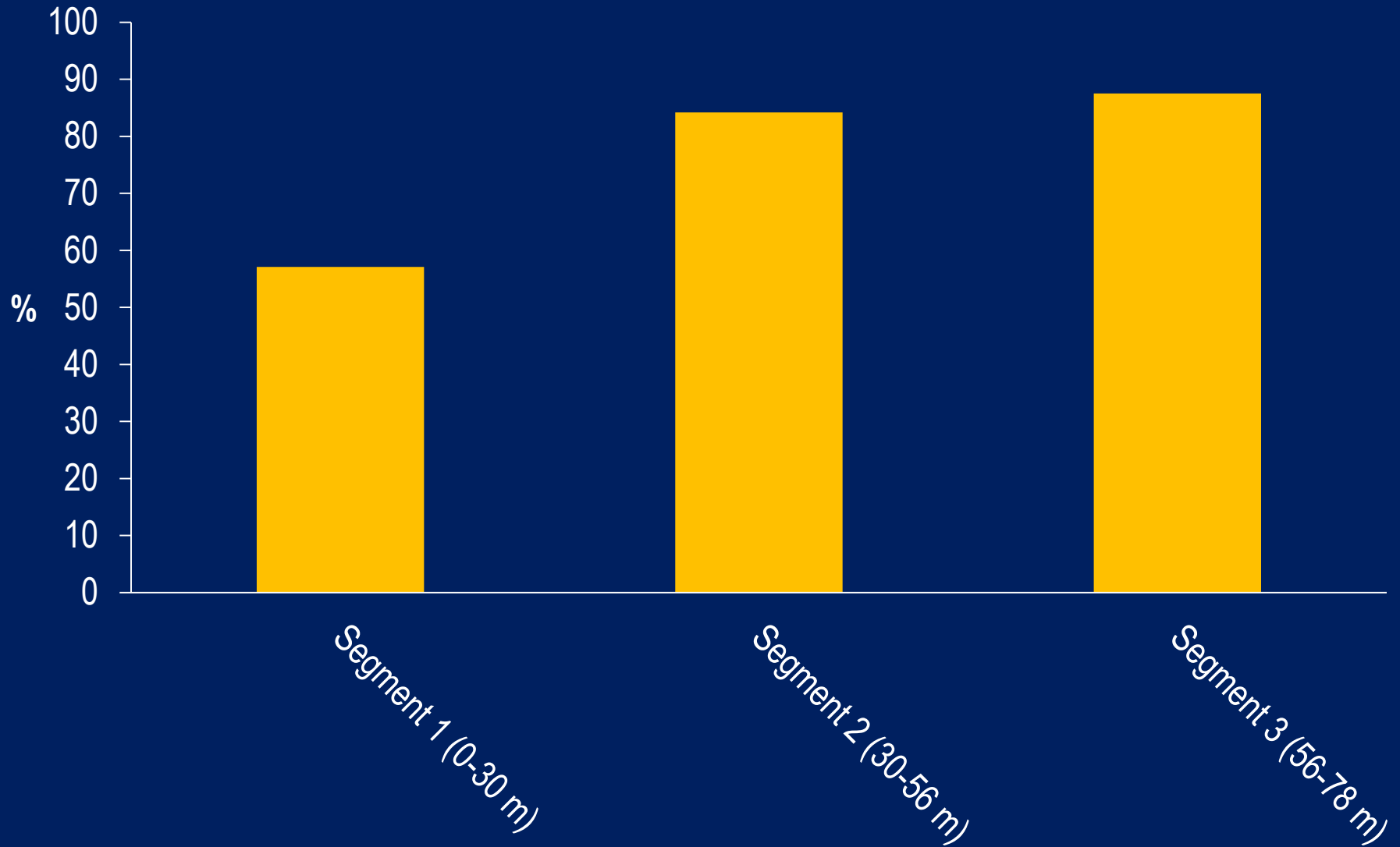
† Segment 1

§ Between Groups

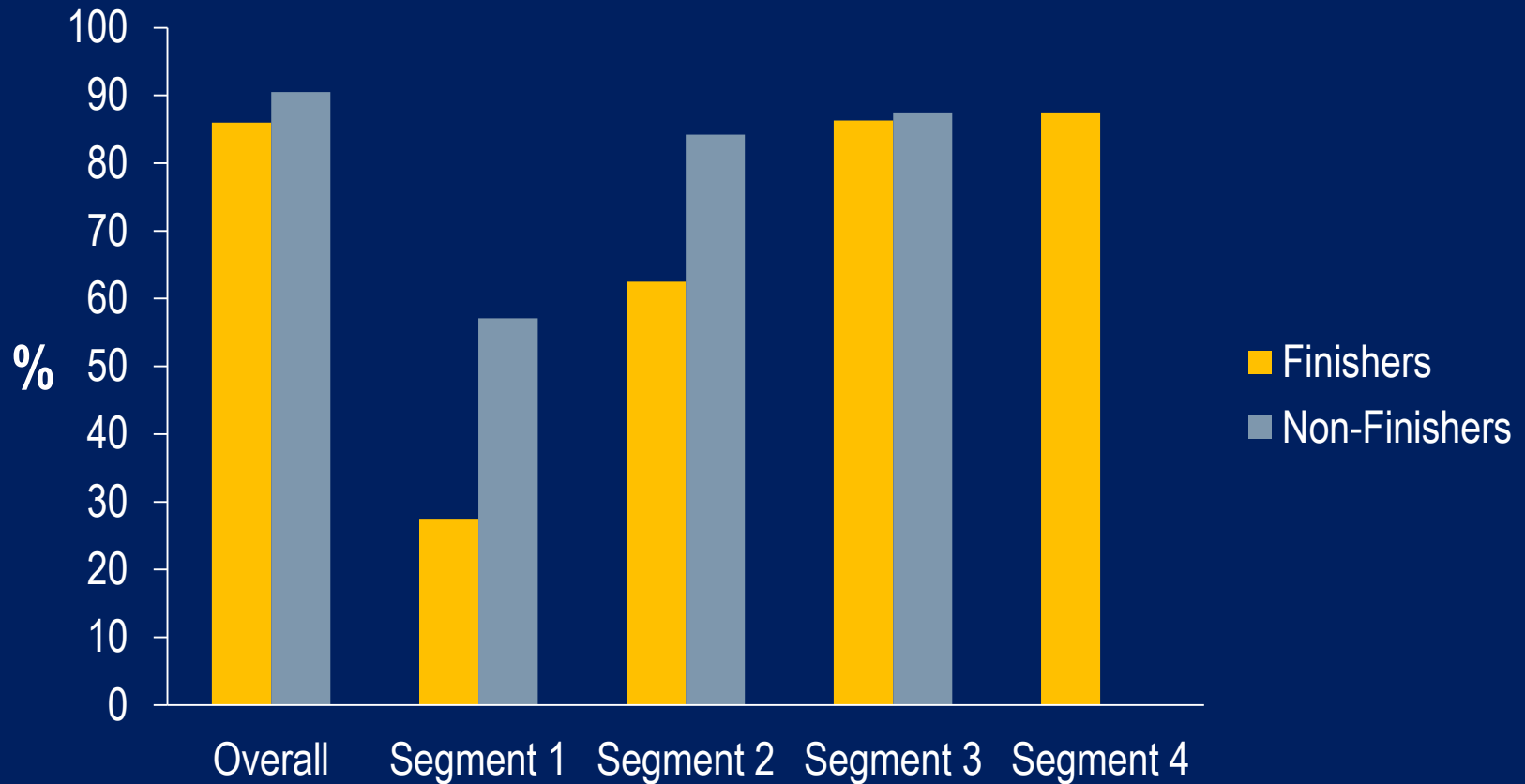
NON-FINISHERS, GI SYMPTOMS REASON FOR DROPPING OUT (36%; n = 21)



NON-FINISHERS NAUSEA FREQUENCY BY SEGMENT



FINISHERS AND NON-FINISHERS NAUSEA



SUMMARY

- GI symptoms experienced by most runners (96%)
- Flatulence (66%), belching (61%), and nausea (60%) most common
- Finishers: GI symptoms affected performance in 44%
 - Nausea most common (86%)
- Non-Finishers: GI symptoms reason for dropping out in 36%
 - Nausea most common (91%)

CONCLUSION

- GI symptoms common during ultramarathon running
 - Nausea most common in:
 - Finishers whose performance was affected by GI distress
 - Non-finishers who dropped out because of GI distress
-

GI Distress at WSER

- Characterization of symptoms
- Potential causes

bathroom? Bathroom?! BATHROOM?!?!?





Causes:

- **Physiology**
- Mechanics
- Nutrition

25 L/min

Cardiac output = 25 L/min

GI hypoperfusion!



Heavy Exercise

100%

3-5%

4-5%

2-4%

0.5-1%

3-4%

80-85%



Rest

100%

20-25%

4-5%

20%

3-5%

15%

4-5%

15-20%

5 L/min

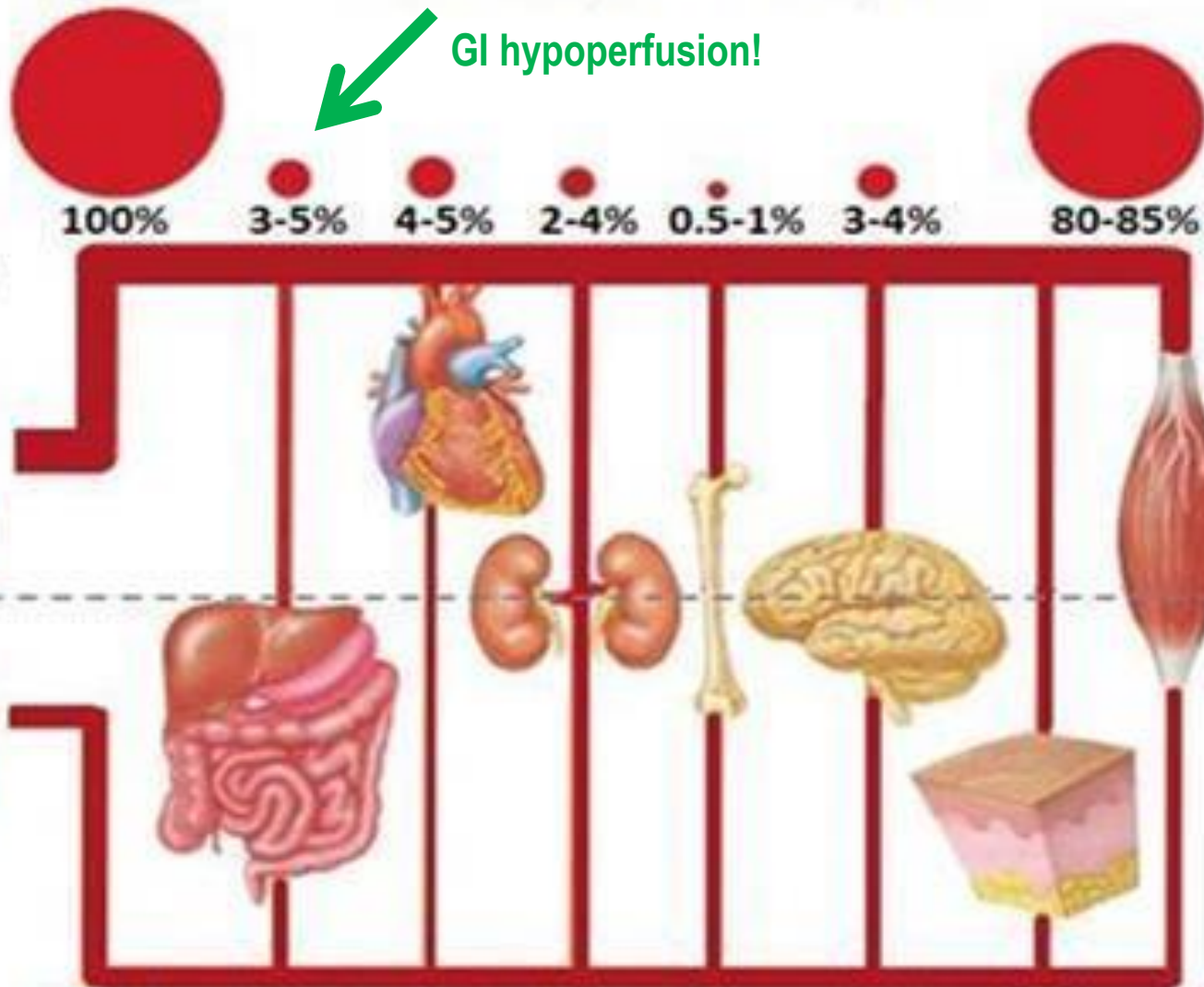
Cardiac output = 5 L/min

~ 20 L/min

Heavy Exercise

Rest

~ 0.75 L/min



↓ GI BLOOD FLOW

Exacerbated by:

- ↑ Exercise intensity
- ↑ Exercise duration
- ↑ Core body temperature
- Dehydration

Mitigated by:

- Food and fluid ingestion

↓ GI BLOOD FLOW CONSEQUENCES



➤ ↓ Motility

➤ ↓ Absorption

➤ ↑ Permeability

↓ MOTILITY

Esophagus

- ↓ Peristalsis
- ↓ LES sphincter tone
- Reflux/heartburn

Stomach

- ↓ gastric emptying
- Stomach bloating
- Stomach cramps
- Nausea
- Vomiting

↓ ABSORPTION



Intestines

- Carbohydrate and water
- Intestinal cramps/pain
- Diarrhea

↑ PERMEABILITY



Intestines

↓ GI blood flow



GI ischemia



Mucosal damage



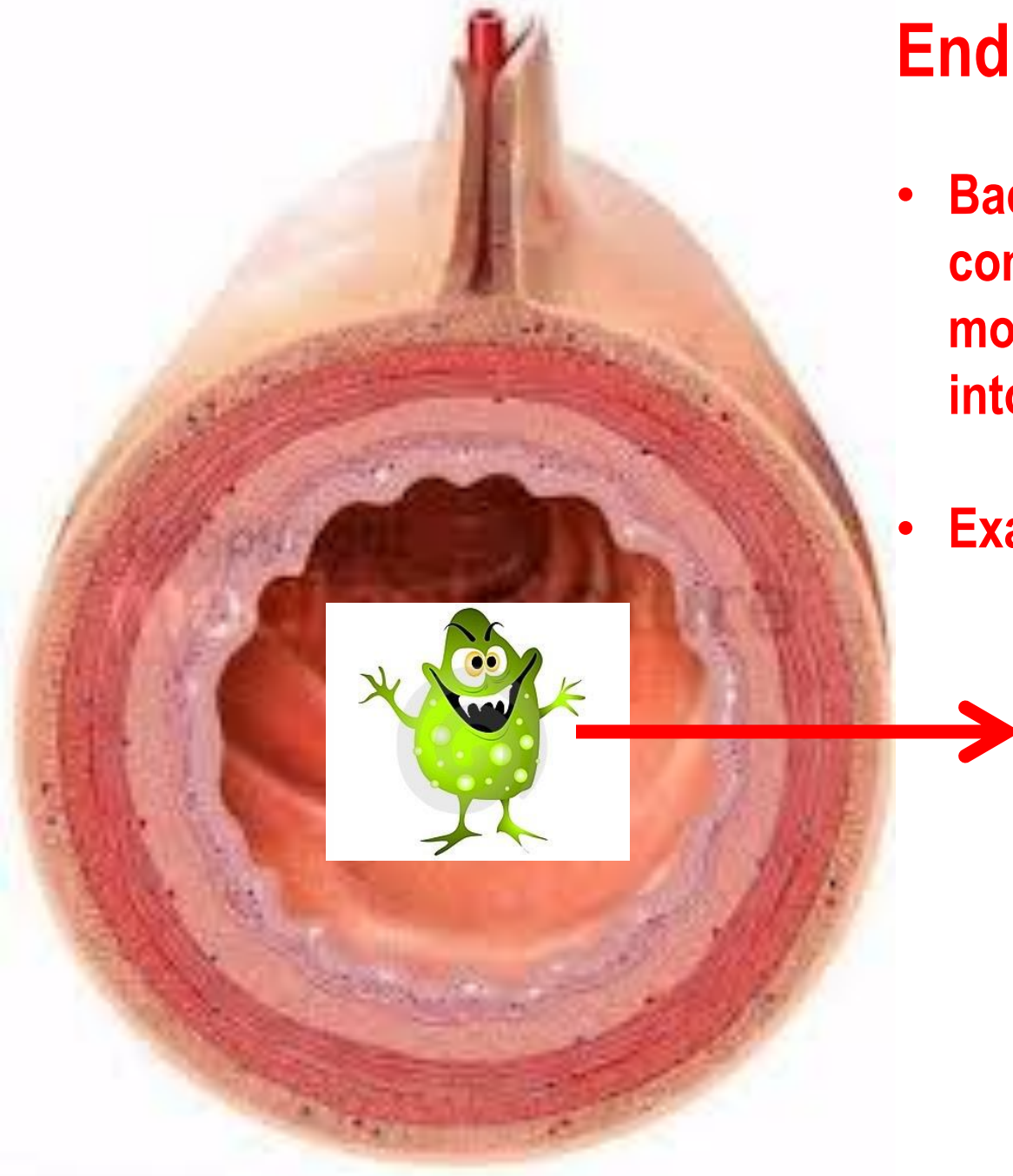
↑ permeability



Endotoxemia

Endotoxemia

- Bacteria or their toxic compounds (endotoxins) move from intestinal lumen into blood
- Example: LPS



LPS

- Elevated blood levels following:
 - ❖ Marathon (Camus 1997)
 - ❖ 89-km ultramarathon (Brock-Utne 1988)
 - ❖ Triathlons (Bosenberg 1988, Jeukendrup 2000)
- LPS correlated with nausea, vomiting, diarrhea (Brock-Utne 1988)
- LPS not correlated with GI symptoms (Jeukendrup 2000)
- LPS cleared from blood within minutes

LPS AND CD14

- LPS stimulates production of receptor CD14
- CD14 membrane bound (mCD14) or soluble (sCD14)
- sCD14 stable marker for LPS
- ↑ sCD14 following marathon (Nielsen 2004)

INFLAMMATORY MARKERS: IL-6 AND CRP

Endotoxemia



Immune response



Intestinal inflammation



↑ IL-6 and CRP

INFLAMMATORY MARKERS: IL-6 AND CRP

Exercise



Immune response



Inflammation

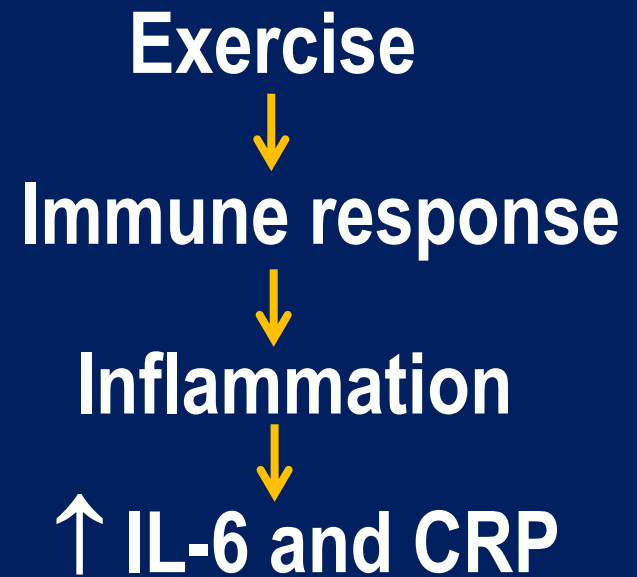
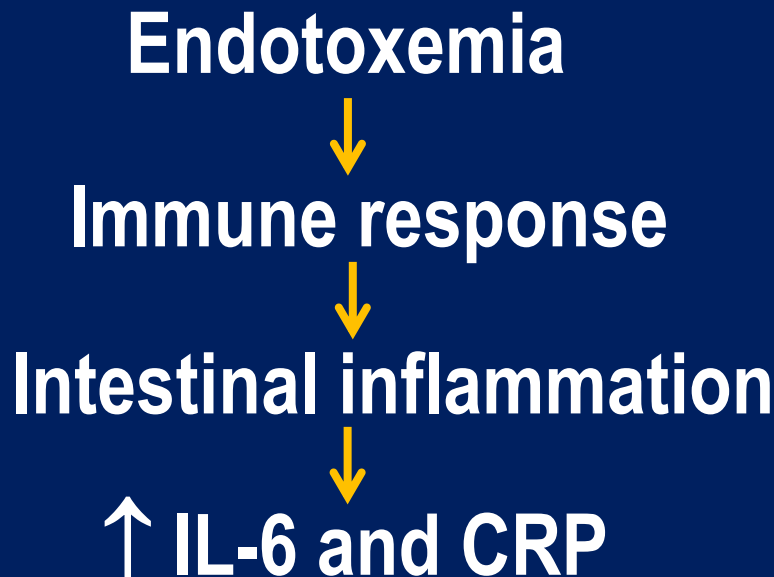


↑ IL-6 and CRP

INFLAMMATORY MARKERS: IL-6 AND CRP

Following a 161-km ultramarathon:

- ↑ IL-6 (Neiman 2003, 2005, 2006)
- ↑ CRP (Neiman 2006)





Causes:

- **Physiology**
- Mechanics
- Nutrition

Repetitive, High-Impact Pounding



GI Symptoms: flatulence, urge to defecate, diarrhea, bloody feces



Causes:

- **Physiology**
- Mechanics
- Nutrition

NUTRITION

Food, Fluid, and Electrolyte Consumption

- No association with GI symptoms (Glance 2002, Rehrer 1992))
- Association with GI symptoms (Stuempfle 2013)
 - ❖ Runners with no symptoms: ↑ fluid intake rate
 - ❖ Runners with no symptoms: ↑ fat intake rate
- More research is needed

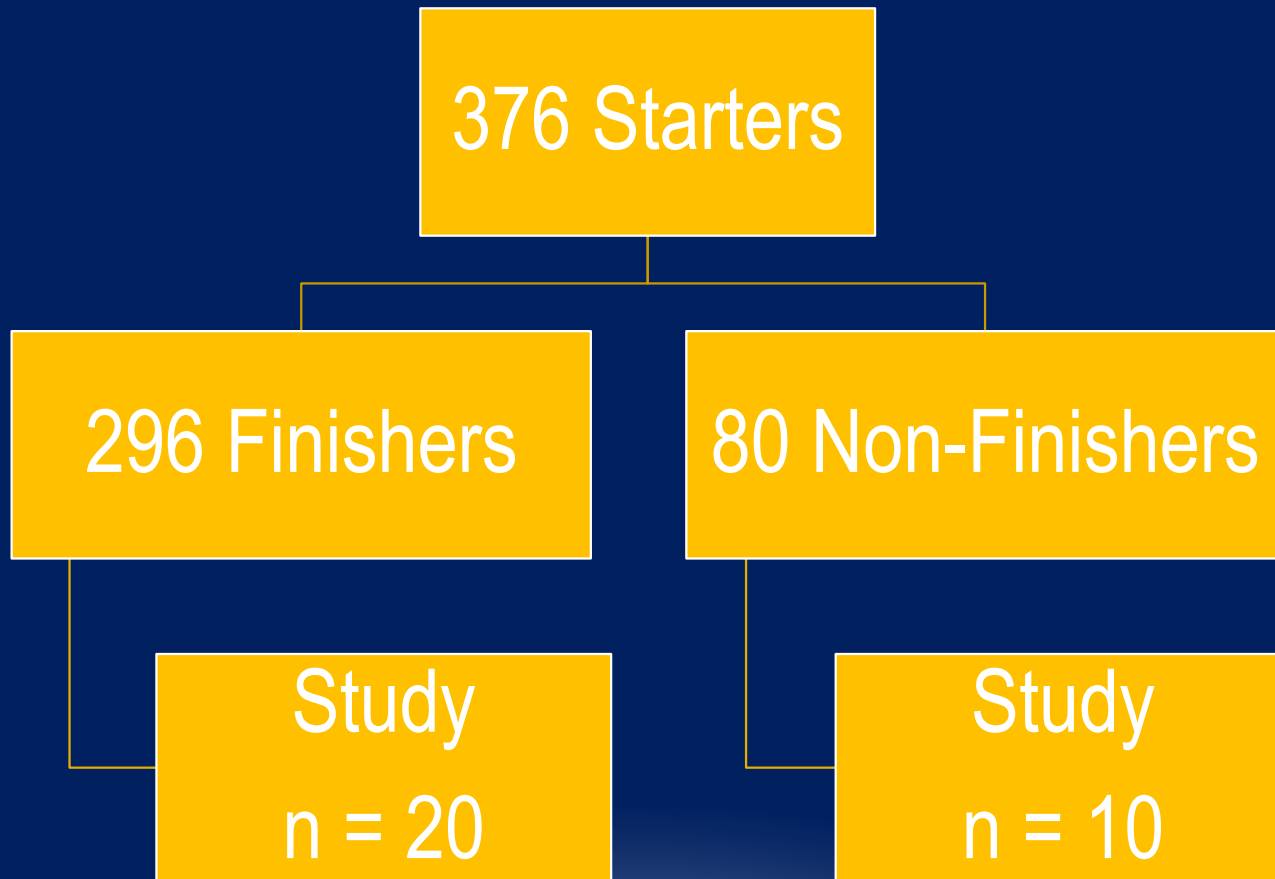
WSER 2014 GI DISTRESS STUDY



PURPOSE

To explore possible contributing factors to GI distress, including endotoxemia, nutrition, hyperthermia, and dehydration during a 161-km ultramarathon

SUBJECTS



Study
n = 30

GI DISTRESS INTERVIEWS



0 m

30 m

56 m

78 m

100 m



Start

Robinson Flat

Michigan Bluff

Rucky Chucky/
River Crossing

Finish

GI SYMPTOMS

Upper GI Symptoms

- Reflex/heartburn
- Belching
- Stomach bloating
- Stomach cramps/pain
- Nausea
- Vomiting

Lower GI Symptoms

- Intestinal cramps/pain
- Flatulence
- Side ache/stitch
- Urge to defecate
- Loose stool/diarrhea
- Intestinal bleeding/bloody feces

GI SYMPTOM SEVERITY

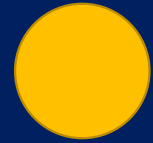
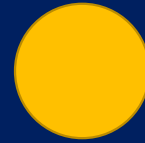
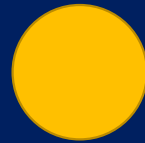
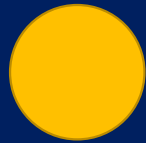
None

Mild

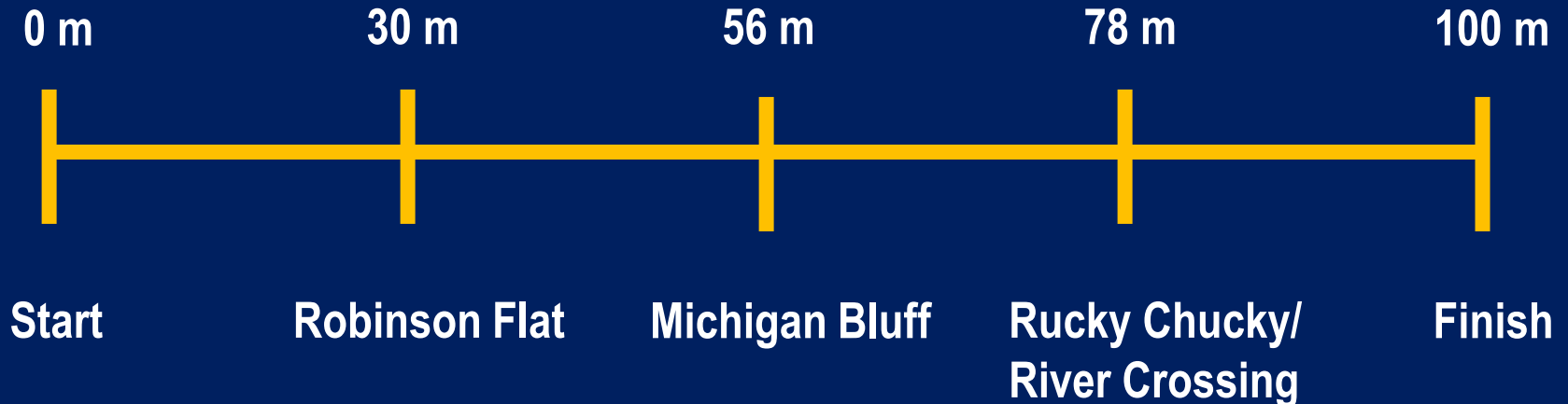
Moderate

Severe

Very Severe



RACE DIET INTERVIEWS



WEIGHTS



0 m

30 m

56 m

78 m

100 m



Start

Robinson Flat

Michigan Bluff

Rucky Chucky/
River Crossing

Finish

CORE TEMPERATURE



0 m

30 m

56 m

78 m

100 m



Start

Robinson Flat

Michigan Bluff

Rucky Chucky/
River Crossing

Finish

BLOOD DRAW



0 m

100 m

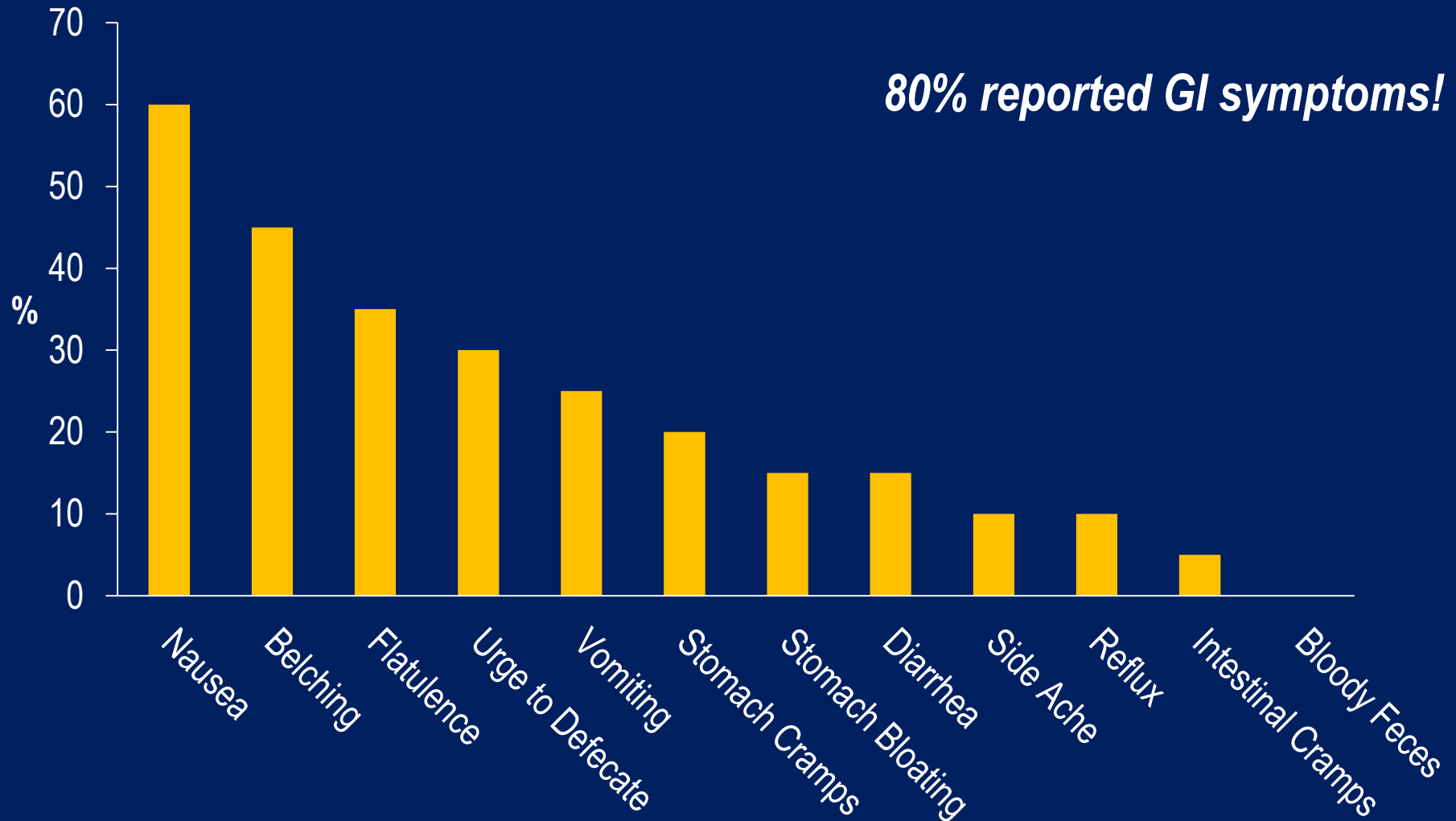
Start

Finish

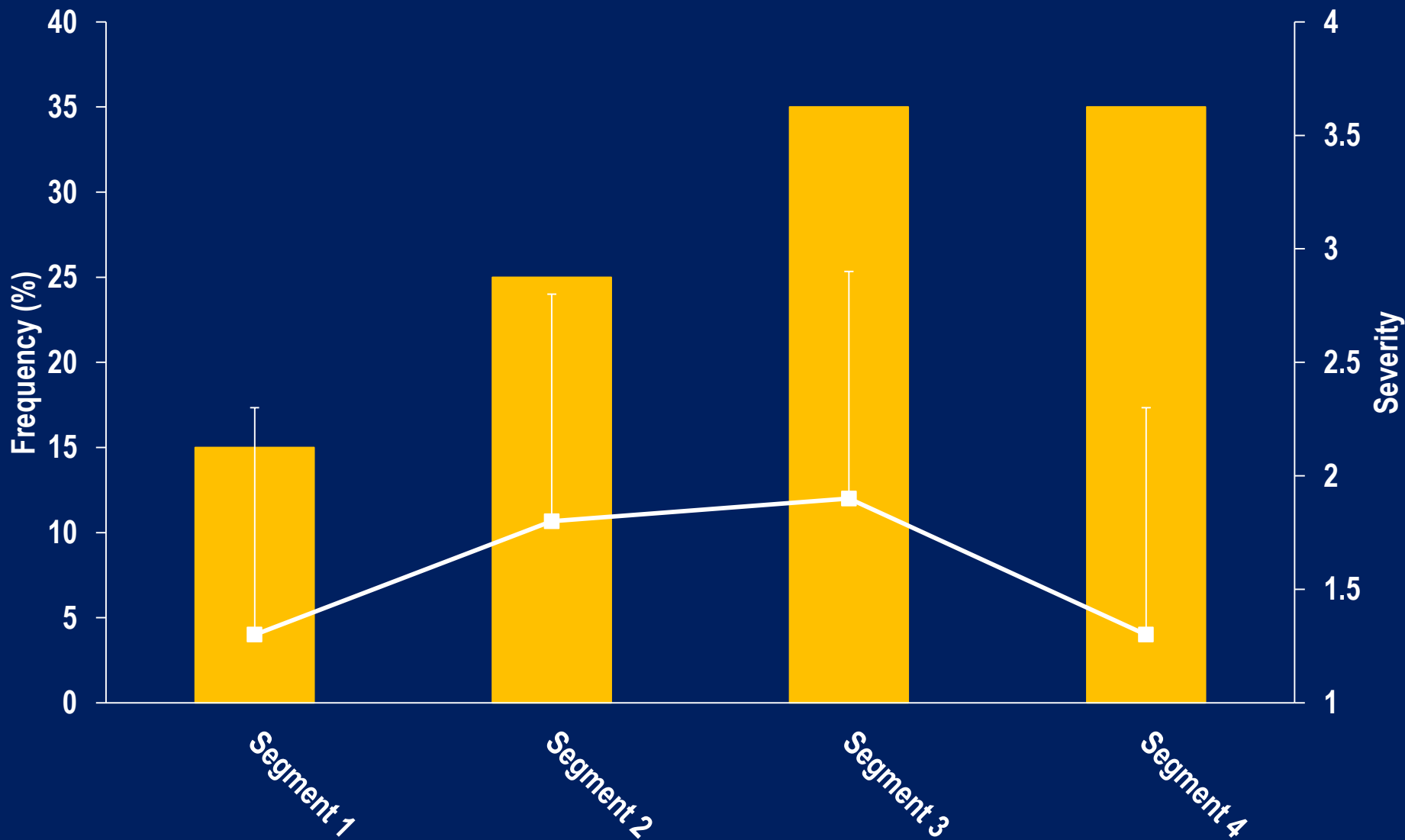
- Endotoxemia marker: **sCD14**
- Inflammatory marker: **IL-6**
- Inflammatory marker: **CRP**

FREQUENCY OF GI SYMPTOMS

(n = 20)



NAUSEA FREQUENCY AND SEVERITY BY SEGMENT

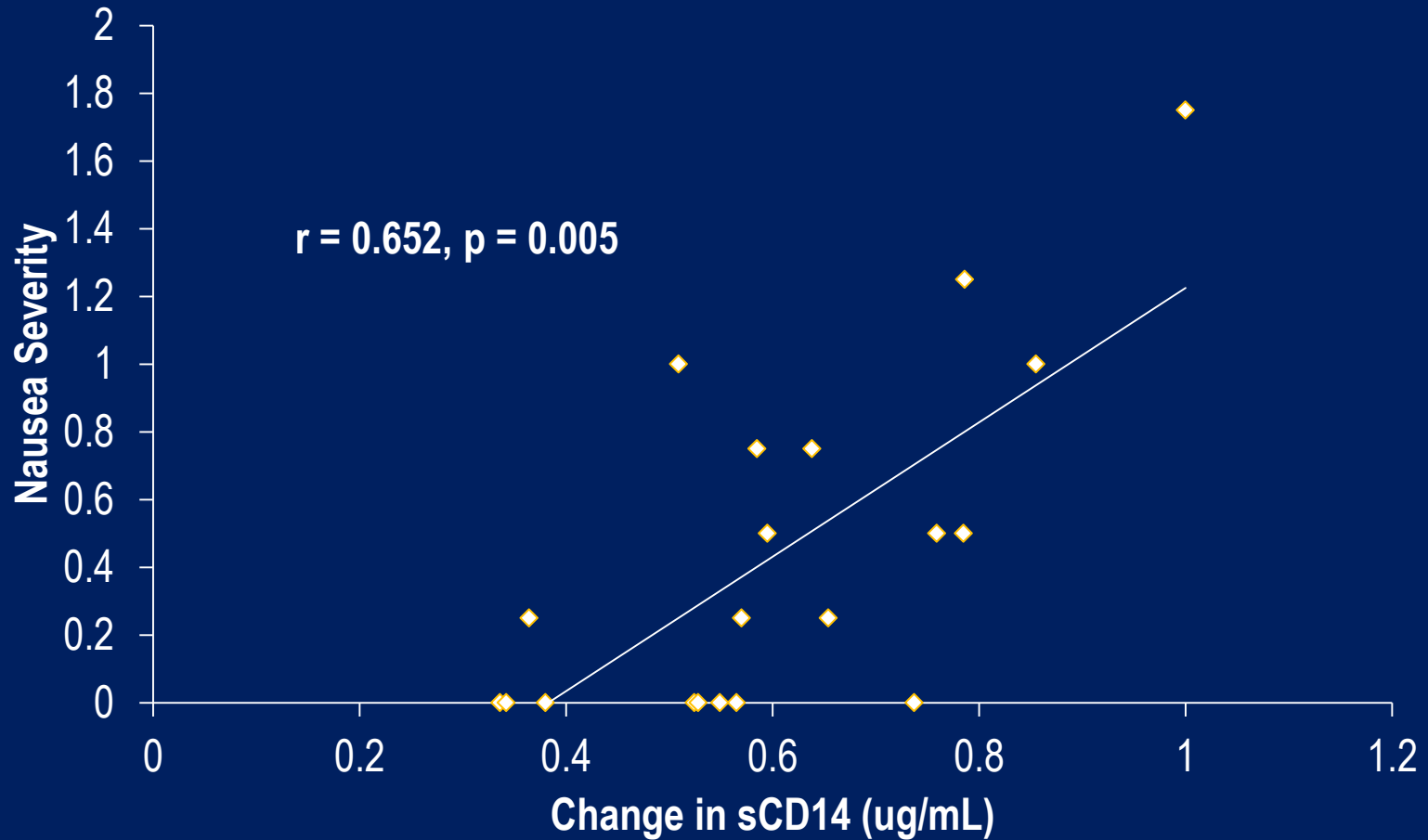


ENDOTOXEMIA MARKER: sCD14

	Without Nausea (n = 8)	With Nausea (n = 12)	Interaction Effect, p
sCD14 (ug/mL)			
Pre-race	1.0 ± 0.1	0.9 ± 0.2	0.02
Post-race	1.5 ± 0.2*	1.6 ± 0.3*	

*p < 0.05 compared with pre-race values

NAUSEA SEVERITY AND Δ sCD14

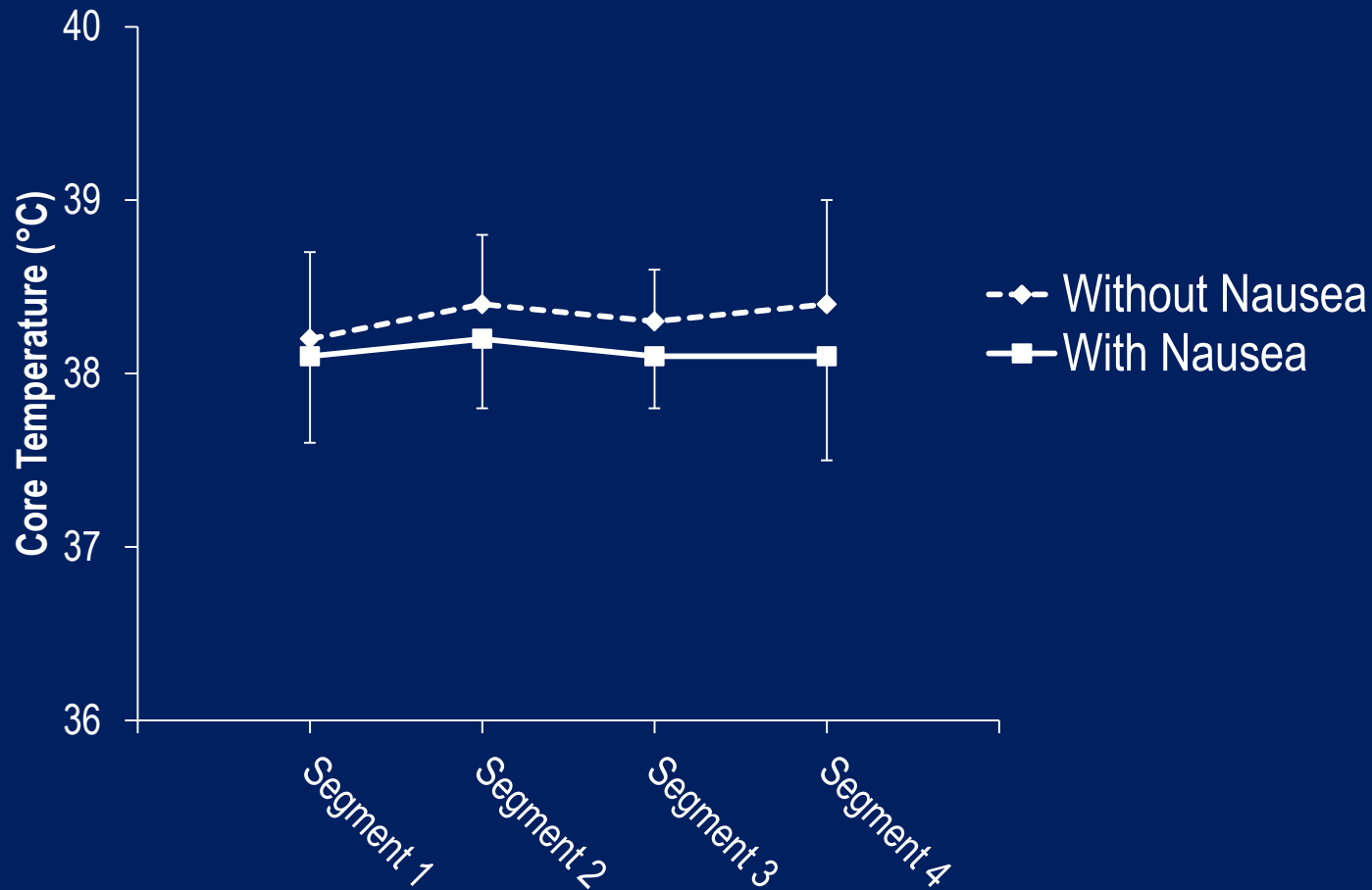


INFLAMMATORY MARKERS: IL-6 AND CRP

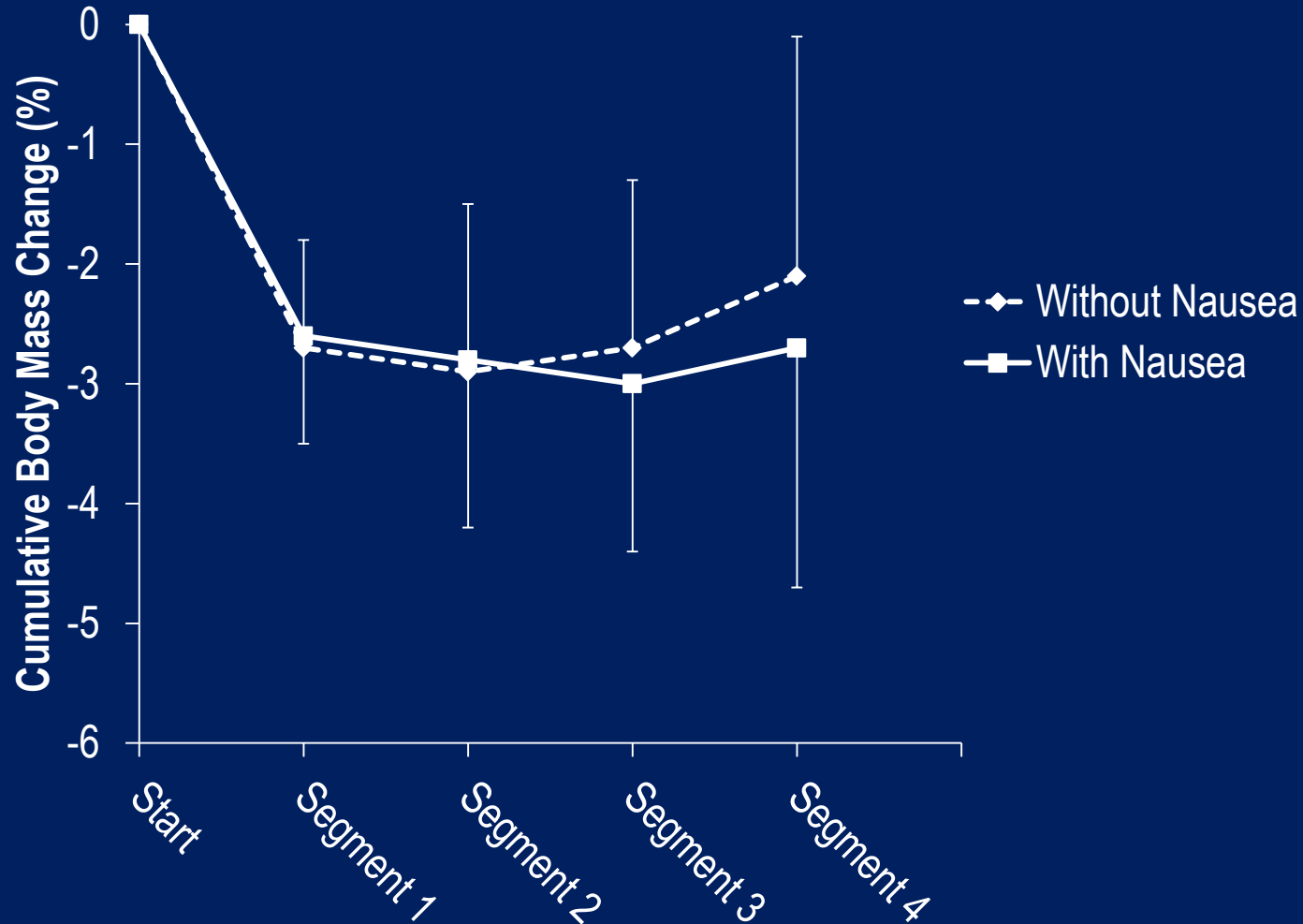
	Without Nausea (n = 8)	With Nausea (n = 12)	Interaction Effect, p
IL-6 (pg/mL)			
Pre-race	0.9 ± 0.4	1.0 ± 0.7	0.33
Post-race	105.7 ± 53.6*	78.6 ± 62.5*	
CRP (ng/mL)			
Pre-race	323 ± 487	1,686 ± 2,607	0.23
Post-race	31,448 ± 13,149*	46,361 ± 29,708*	

*p < 0.05 compared with pre-race values

CORE TEMPERATURE



BODY MASS CHANGE



OVERALL RACE DIET

Variable	Without Nausea (n = 8)	With Nausea (n = 12)	p
Energy Rate, kcal/kg/h	3.2 ± 1.3	2.6 ± 1.1	0.21
Proportion as Carbohydrate, %	80.6 ± 7.9	83.2 ± 10.0	0.54
Carbohydrate Rate, g/kg/h	0.7 ± 0.3	0.6 ± 0.2	0.36
Proportion as Fat, %	13.5 ± 5.9	11.7 ± 7.3	0.56
Fat Rate, g/kg/h	0.05 ± 0.02	0.03 ± 0.03	0.30
Proportion as Protein,%	5.9 ± 3.5	5.1 ± 3.0	0.60
Protein Rate, g/kg/h	0.05 ± 0.03	0.03 ± 0.02	0.22
Fluid Rate, ml/kg/h	7.33 ± 1.86	6.58 ± 2.20	0.44

SUMMARY

- GI symptoms experienced by most runners (80%)
- Nausea most common (60%)
- Runners with nausea had greater endotoxemia
- Significant positive correlation between nausea severity and endotoxemia
- Inflammatory response, core temperature, hydration level and nutrition similar between runners with and without nausea

CONCLUSION

- Endotoxemia linked to nausea in ultramarathon runners
- Other possible contributing factors (hyperthermia, dehydration, nutrition) did not appear to play a role in
nausea

THANK YOU

