GASTROINTESTINAL DISTRESS IN ULTRAMARATHON RUNNERS

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June 24, 2014
“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.
GI DISTRESS

- 37-60% of runners in 67-161 km races

- 161 km races:
  - Non-finishers: 1\textsuperscript{st} reason for dropping out
  - Finishers: 2\textsuperscript{nd} issue impacting performance
Causes:

- Physiology *
- Mechanical
- Nutrition
GI BLOOD FLOW CONSEQUENCES

- Motility changes
- Absorption changes
- Gut permeability changes
CHANGES IN MOTILITY: ESOPHAGUS

- ↓ peristalsis
- ↓ LES sphincter tone

GI Symptom:
- Reflux/heartburn
CHANGES IN MOTILITY: STOMACH

Gastric Emptying:
• Moderate exercise: ↔
• Intense exercise: ↓
• Dehydration: ↓

GI Symptoms:
• Stomach bloating
• Stomach cramps
• Nausea
• Vomiting
GI BLOOD FLOW CONSEQUENCES

- Motility changes
- Absorption changes
- Gut permeability changes
ABSORPTION CHANGES
CARBOHYDRATE AND WATER

• Moderate intensity: ↔
• < 2 hours: ↔
• ↑ intensity: ↓ absorption?
• ↑ duration: ↓ absorption?
Motility changes
Absorption changes
Gut permeability changes
GUT PERMEABILITY CHANGES

- ↓ GI blood flow may ↑ intestinal permeability and bacterial translocation
- May be linked to GI symptoms
- More research needed!
• Consequences:
  ➢ Motility changes
  ➢ Absorption changes
  ➢ Gut permeability changes

• Exacerbated by:
  ➢ ↑ exercise intensity or duration
  ➢ ↑ environmental temperature
  ➢ Dehydration
Causes:
- Physiology *
- Mechanical
- Nutrition
Physical Impact and Jostling

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

- Physiology *
- Mechanical
- Nutrition
More research is needed!
NUTRITION: FLUID BALANCE

Hyperhydration

Hyponatremia: Nausea

Dehydration: Nausea

Hypohydration
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

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

SurveyMonkey.com
because knowledge is everything
<table>
<thead>
<tr>
<th>Upper GI Symptoms</th>
<th>Lower GI Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflux/heartburn</td>
<td>Intestinal cramps/pain</td>
</tr>
<tr>
<td>Belching</td>
<td>Flatulence</td>
</tr>
<tr>
<td>Stomach bloating</td>
<td>Side ache/stitch</td>
</tr>
<tr>
<td>Stomach cramps/pain</td>
<td>Urge to defecate</td>
</tr>
<tr>
<td>Nausea</td>
<td>Loose stool/diarrhea</td>
</tr>
<tr>
<td>Vomiting</td>
<td>Intestinal bleeding/bloody feces</td>
</tr>
</tbody>
</table>
GI SYMPTOMS BY RACE SEGMENT

0 m  30 m  56 m  78 m  100 m
Segment 1  Segment 2  Segment 3  Segment 4
Start  Robinson Flat  Michigan Bluff  Rucky Chucky/River Crossing  Finish
GI SYMPTOM SEVERITY

None  Mild  Moderate  Severe  Very Severe

0  1  2  3  4
SUBJECTS

383 Starters

277 Finishers
- Survey n=212 (76.5%)
  25.8 ± 3.3 h

106 Non-Finishers
- Survey n=60 (56.6%)
  18.0 ± 6.1 h

Survey n=272
FREQUENCY OF GI SYMPTOMS

(\textit{n} = 272)

\textbf{96\% reported GI symptoms!}
SEVERITY OF GI SYMPTOMS

(n = 272)
If

- Flatulence
- Belching
- Nausea
- Stomach bloating

➢ In the past while running

Then

- Flatulence
- Belching
- Nausea
- Stomach bloating

➢ During the WSER 2013
If 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)

* Frequency > Segment 1
† Frequency > Segment 2
CUMULATIVE BODY MASS CHANGE FOR FINISHERS BY NAUSEA STATUS

Cumulative Body Mass Change (%)

Without Nausea
With Nausea

* < Start
† Segment 1
§ Between Groups
NON-FINISHERS, GI SYMPTOMS REASON FOR DROPPING OUT

(36%; n = 21)
NON-FINISHERS NAUSEA FREQUENCY BY SEGMENT

% of non-finishers experiencing nausea by segment:
- Segment 1 (0-30 m): 50%
- Segment 2 (30-56 m): 80%
- Segment 3 (56-78 m): 90%
FINISHERS AND NON-FINISHERS NAUSEA

Overall Segment 1 Segment 2 Segment 3 Segment 4

% Finishers Non-Finishers
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
Causes:
• Physiology *
• Mechanical
• Nutrition
IS RACE DIET ASSOCIATED WITH GI DISTRESS?
Are food and fluid intake associated with GI distress in a 161-km ultramarathon?
Javelina Hundred
SUBJECTS

15 runners

- 10 male
- 5 female
### RACE DIET INTERVIEWS

<table>
<thead>
<tr>
<th>Loop 1</th>
<th>Loop 2</th>
<th>Loop 3</th>
<th>Loop 4</th>
<th>Loop 5</th>
<th>Loop 6</th>
<th>Loop 7</th>
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</thead>
<tbody>
<tr>
<td>0 km</td>
<td>25 km</td>
<td>50 km</td>
<td>75 km</td>
<td>100 km</td>
<td>125 km</td>
<td>150 km</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>161 km</td>
</tr>
</tbody>
</table>

---

![People sitting at a table with cups and paper]
Tom Jackson

\[ \frac{20}{11} \]

\[ \frac{4}{11} \]

\[ \frac{1}{2} \text{ lbs} \]

\[ \frac{3}{11} \text{ cups} \]

\[ \frac{1}{2} \text{ lb} \text{ meat} \]

\[ \frac{1}{2} \text{ lb} \text{ meat} \]

\[ 3 \text{ in. } \]

\[ 2 \text{ in.} \]

\[ 1 \text{ lb} \text{ meat} \]

\[ 1 \text{ lb} \text{ meat} \]

\[ 1 \text{ lb} \text{ meat} \]

\[ \text{Tom Jackson} \]

\[ \text{Mr. Jones Pay Day} \]

\[ \text{last chance} \]

\[ \text{last chance} \]

\[ \text{last chance} \]

\[ \text{last chance} \]

\[ \text{last chance} \]

\[ \text{last chance} \]

\[ \text{last chance} \]

\[ \text{last chance} \]

\[ \text{last chance} \]
Client Diet Record Nutrition Summary

First Name: Beth
Middle Name: 
Last Name: Vitalia
Company: NutriSante
Date of Birth: 
Weight: 
Total Days: 1 
Avg. Daily Kcal: 10298.480
Total Foods: 32
Diet Name: WS 2009 Vitalia

**Macronutrients**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Value</th>
<th>Unit</th>
<th>Goal</th>
<th>%</th>
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<tbody>
<tr>
<td>Kilocalories</td>
<td>10298.48</td>
<td>kcal</td>
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<tr>
<td>Protein</td>
<td>130.642</td>
<td>g</td>
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<tr>
<td>Carbohydrate</td>
<td>2307.925</td>
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<tr>
<td>Fat, Total</td>
<td>62.779</td>
<td>g</td>
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<tr>
<td>Alcohol</td>
<td>0.000</td>
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<tr>
<td>Cholesterol</td>
<td>110.602</td>
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<tr>
<td>Saturated Fat</td>
<td>14.671</td>
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<tr>
<td>Monounsaturated Fat</td>
<td>27.939</td>
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<tr>
<td>Polyunsaturated Fat</td>
<td>14.645</td>
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<tr>
<td>MFA 18:1, Oleic</td>
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<tr>
<td>PFA 18:2, Linoleic</td>
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<tr>
<td>PFA 18:3, Linolenic</td>
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<td>PFA 20:5, EPA</td>
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<td>PFA 22:6, DHA</td>
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<tr>
<td>Dietary Fiber, Total</td>
<td>13.287</td>
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<tr>
<td>Sugar, Total</td>
<td>897.340</td>
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**Amino Acids**

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<th>Value</th>
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<td>Tryptophan</td>
<td>1251.140</td>
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<tr>
<td>Threonine</td>
<td>3841.823</td>
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<tr>
<td>Isoleucine</td>
<td>4353.529</td>
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<tr>
<td>Leucine</td>
<td>8720.817</td>
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<tr>
<td>Lysine</td>
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<tr>
<td>Methionine</td>
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<td>Cystine</td>
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<td>Phenylalanine</td>
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<tr>
<td>Tyrosine</td>
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<td>Valine</td>
<td>5118.400</td>
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<tr>
<td>Histidine</td>
<td>2138.030</td>
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**Vitamins**

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<th>Vitamin</th>
<th>Value</th>
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<th>Goal</th>
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<tbody>
<tr>
<td>Vitamin A (RE)</td>
<td>2306.320</td>
<td>RE</td>
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<tr>
<td>Beta-Carotene</td>
<td>2832.852</td>
<td>µg</td>
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<tr>
<td>Vitamin C</td>
<td>2643.795</td>
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<tr>
<td>Vitamin D (µg)</td>
<td>30.228</td>
<td>µg</td>
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<tr>
<td>Vitamin E (mg)</td>
<td>773.799</td>
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<tr>
<td>Alpha-Tocopherol</td>
<td>3.210</td>
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<tr>
<td>Thiamin</td>
<td>0.680</td>
<td>mg</td>
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<tr>
<td>Riboflavin</td>
<td>5.326</td>
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<tr>
<td>Niacin</td>
<td>70.436</td>
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<tr>
<td>Pyridoxine (Vitamin B6)</td>
<td>7.390</td>
<td>mg</td>
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<tr>
<td>Folate (Total)</td>
<td>1251.250</td>
<td>µg</td>
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<tr>
<td>Cobalamin (Vitamin B12)</td>
<td>20.065</td>
<td>µg</td>
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<tr>
<td>Biotin</td>
<td>2106.602</td>
<td>µg</td>
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<tr>
<td>Pantothenic Acid</td>
<td>71.672</td>
<td>mg</td>
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<tr>
<td>Vitamin K</td>
<td>211.629</td>
<td>µg</td>
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</table>

**Minerals**

<table>
<thead>
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<th>Value</th>
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<th>Goal</th>
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<tr>
<td>Sodium</td>
<td>23290.48</td>
<td>mg</td>
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<td></td>
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<tr>
<td>Potassium</td>
<td>8765.444</td>
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<tr>
<td>Calcium</td>
<td>3378.622</td>
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<tr>
<td>Iron</td>
<td>40.063</td>
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<tr>
<td>Phosphorus</td>
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<tr>
<td>Magnesium</td>
<td>1031.990</td>
<td>mg</td>
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<tr>
<td>Zinc</td>
<td>38.151</td>
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<tr>
<td>Copper</td>
<td>5.276</td>
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<tr>
<td>Manganese</td>
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<tr>
<td>Selenium</td>
<td>173.977</td>
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<tr>
<td>Chromium</td>
<td>1.300</td>
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<tr>
<td>Molybdenum</td>
<td>222.033</td>
<td>µg</td>
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</tr>
</tbody>
</table>

**Percentage Of Kcal**

- Protein 5.0%
- Carbohydrate 89.7%
- Total Fat 5.4%
- Alcohol 0.0%

Monday, August 31, 2009
GI DISTRESS

No
40%

Yes
60%

3 F
3 NF

4 F
5 NF

---

Loop 1: 9 with, 6 without
Loop 2: 5 w, 4 w/out
Loop 3: 4 with, 3 without
Loop 4: 4 with, 3 without
Loop 5: 5 w, 4 w/out
Loop 6: 4 with, 3 without
Loop 7: 4 with, 3 without

km:
0 km 25 km 50 km 75 km 100 km 125 km 150 km 161 km
Start loops 3 and 4 (50-100 km; 31-62 m)

GI SYMPTOM FREQUENCY

- Nausea: 90%
- Vomiting: 40%
- Abdominal Cramps: 40%
- Diarrhea: 20%
<table>
<thead>
<tr>
<th>Variable</th>
<th>W/out GI Distress (n = 6)</th>
<th>W/ GI Distress (n = 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>42.2 ± 11.1</td>
<td>49.9 ± 11.2</td>
</tr>
<tr>
<td>Years running</td>
<td>10.7 ± 8.0</td>
<td>19.6 ± 14.6</td>
</tr>
<tr>
<td>Previous ultramarathons completed</td>
<td>4.7 ± 2.9</td>
<td>25.1 ± 36.2</td>
</tr>
<tr>
<td>Previous 161-km races completed</td>
<td>1.3 ± 2.0</td>
<td>4.8 ± 7.9</td>
</tr>
<tr>
<td>Kilometers</td>
<td>137.7 ± 30.2</td>
<td>128.7 ± 30.7</td>
</tr>
<tr>
<td>Time (h)</td>
<td>22.5 ± 5.4</td>
<td>22.9 ± 5.2</td>
</tr>
</tbody>
</table>
CUMULATIVE % BODY MASS CHANGE BY LOOP

* p< 0.05 in runners with GI distress between the start and loops 2, 3, and 4
RACE DIET COMPOSITION

Without GI Distress

- Carbohydrate: 74.2%
- Protein: 9.3%
- Fat: 16.5%

With GI Distress

- Carbohydrate: 79.5%
- Protein: 9.3%
- Fat: 11.1%

*p < 0.05 in runners without GI distress versus runners with GI distress.
KCAL RATE

Without GI Distress: 3.4 kcal/kg/h
With GI Distress: 2.3 kcal/kg/h
CARBOHYDRATE RATE

Without GI Distress: 0.65 g/kg/h
With GI Distress: 0.45 g/kg/h
Without GI Distress: 0.06 g/kg/h
With GI Distress: 0.03 g/kg/h

*p < 0.05 in runners without GI distress versus runners with GI distress.
FAT RATE BY LOOP

-0.02
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14

g/kg/h

Without GI Distress
With GI Distress

Start
GI DISTRESS

Loop 1
Loop 2
Loop 3
Loop 4
Loop 5
Loop 6
Loop 7

* p< 0.05 in runners without GI distress versus runners with GI distress.
FLUID RATE

Without GI Distress

With GI Distress

* < 0.05 in runners without GI distress versus runners with GI distress.
FLUID RATE BY LOOP

* p< 0.05 in runners without GI distress versus runners with GI distress.
RUNNERS W/OUT GI DISTRESS > RUNNERS W/ GI DISTRESS

- % Fat
- Fat consumption rate (g/kg/h)
- Fluid consumption rate (ml/kg/h)
- Differences evident *before* GI symptoms
CONCLUSION

Fluid and fat consumption *may* protect ultramarathoners from GI distress.
WSER 2014 GI DISTRESS STUDY

n = 20
## 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
RACE DIET INTERVIEWS

0 m       30 m       56 m       78 m       100 m
Start     Robinson Flat  Michigan Bluff  Rucky Chucky/River Crossing  Finish
WEIGHTS

Start  Robinson Flat  Michigan Bluff  Rucky Chucky/River Crossing  Finish

0 m  30 m  56 m  78 m  100 m
BLOOD DRAW

Biomarkers

- LPS
- sCD14
- IL-6
- CRP
INTERESTED IN BEING A SUBJECT?

Taylor Valentino

Kristin Stuempfle
THANK YOU