Sex-Differences in Within-Day Energy Balance in Elite Division 1 Swimmers

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Physiological Importance of Energy Balance

- Energy demands left unmet will result in energy reallocation to vital processes.


Measuring Energy Balance

- **Direct measures**: Measuring energy intake (dietary recording) and energy expenditure (wearable technology – HR monitors/accelerometers)

- **Surrogate measures** assess metabolic adaptations to chronic energy deficiency
  - ↓ resting metabolic rate (RMR): Measured-to-Predicted RMR ratio
  - ↓ metabolic hormones: TT3, IGF-1, leptin, insulin
Current research focuses on day-to-day energy balance (24h).

**WDEB** examines the fluctuations in energy intake and energy expenditure in 1-hour intervals to account for the endocrine responses that follow real-time changes in energy intake and expenditure.
Cross-Sectional Study Design

Participants

n=25 Swimmers
Methods – Main Variables of Interest

Single Time Laboratory Measures Collected

• Resting metabolic rate (RMR): laboratory measure using indirect calorimetry using a metabolic cart
• Triiodothyronine (TT3): laboratory serum sample

Collected Daily

• Exercise Energy Expenditure: measured using the WHOOP wearable device
• Energy Intake: assessed using time-stamped dietary recordings via the MyFitnessPal mobile application

Overall Energy Balance (EB) & WDEB

- 84% (21/25) of swimmers met or exceeded TDEB
- 16% (4/25) ended the day in an energy deficit.
Sex Differences in WDEB

- Males had significantly higher EI (3959 kcal ± 715 vs 2260 kcal ± 431) and EB (+758 kcal ± 702 vs +52 kcal ± 505) than females.

- Females spent more time in negative EB than males (17hrs ± 5 vs 13hrs ± 4).

- Males exhibited greater EB values across the day, driven by greater hourly EI (normalized) while EE did not differ.
In the metabolically suppressed group (n=12):
- TT₃ was negatively correlated with consecutive hours spent in negative EB (R=-0.604, p=0.049)
- TT₃ was positively correlated to time spent in energy balance (R=0.740, p=0.009)

Sub-analysis: Individuals who were in EB/surplus (n=21)
- Those who consumed ≥50% of EI after 1700 hours had significantly lower TT₃ (79.3 ng/dL vs 92.9 ng/dL, p=0.009) vs. those in whom kcals were distributed more evenly.
Significance of Findings

- EB and WDEB analyses conducted over two weeks of heavy training in Division 1 swimmers indicate a greater risk of energy deficiency in females than males.
- WDEB analyses may capture indices of metabolic compensation i.e., low TT3 associated with backloading calories and or not eating for long stretches during the day, not evident with EB analyses alone.
Thank You!