Energy Availability in Female Collegiate Beach Volleyball Athletes

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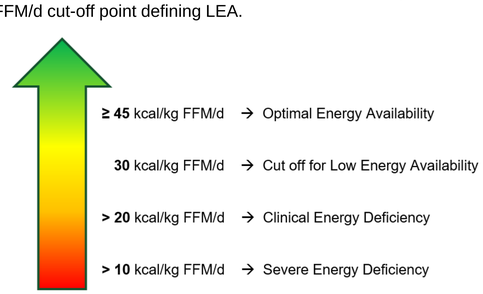
Abstract

INTRODUCTION: Energy availability (EA) is the amount of energy available for normal physiological processes and is defined as energy intake (kcals) minus exercise energy expenditure (kcals) relative to fat free mass (FFM). Low-energy availability (LEA), energy intake < 30 kcal/kg FFM/d, is the core cause of the Female Athlete Triad and Relative Energy Deficiency in Sport. These conditions result in various negative health and performance outcomes. A recent study (N=121) reported 81% of female collegiate athletes exhibited LEA. Of the 18-collegiate beach volleyball (BVB) athletes studied, average EA across 7 days was determined to be 12.44 kcal/kg FFM/d, far below the cutoff for LEA. Recently, the training and competitive demands of collegiate BVB were estimated to be 100-110 kcal/kg per week. Mean energy expenditure during competitive matches and corresponding warm-ups was found to be 15 kcal/kg. Given such high energetic demands of BVB and the known presence of LEA in these athletes, adequate nutrition across the competitive season becomes paramount. Notably, this is a 7-day snapshot of EA that may not reflect chronic dietary or training patterns. To our knowledge, no study has examined EA across the 10-week competitive season in this population. Therefore, the purpose of this cross-sectional study is to establish the current risk of LEA in female collegiate BVB athletes across the competitive season. **METHODS:** We recruited 12 female collegiate BVB athletes. However, due to injury (N=2), 10 subjects completed the protocol. Independent samples t-tests (for incomplete data sets) or paired samples t-tests (for complete data sets) were used to determine significance. Each subject completed an initial visit where anthropometrics, resting metabolic rate (RMR), nutrition knowledge, psychological skills, body composition, countermovement vertical jump (CMJ) height, velocity, power (GymAware) and maximal aerobic capacity were tested. All variables, excluding VO_2max, were reassessed during Week 5 and 9 of the competitive season. Energy intake (ASA 24) and energy expenditure (GT9X-Link) were assessed to calculate EA at Week 1, 5 and 9. Results were analyzed using independent-sample t-tests. **RESULTS:** All measures of body composition and nutrition knowledge were maintained. CMJ performance without an armswing increased from Week 1 to Week 5 (p=0.043). No statistical differences were found between Weeks 1 and 5 for energy intake (p=0.849) and physical activity (p=0.055). Although not statistically significant, energy availability increased from Week 1 (28.13 ± 7.67 kcal/kg FFM) to Week 5 (35.13 ± 8.90 kcal/kg FFM) (p=0.114). **DISCUSSION:** The threshold for LEA is 30 kcal/kg FFM/d. While there was no statistical difference from Weeks 1 to 5, energy availability was physiologically and meaningfully improved during this time. Energy availability at Week 1 was below the threshold for LEA, while energy availability at Week 5 was above this threshold. The risk for LEA was present among the participants at Week 1, however as the season progressed energy availability improved.

Background

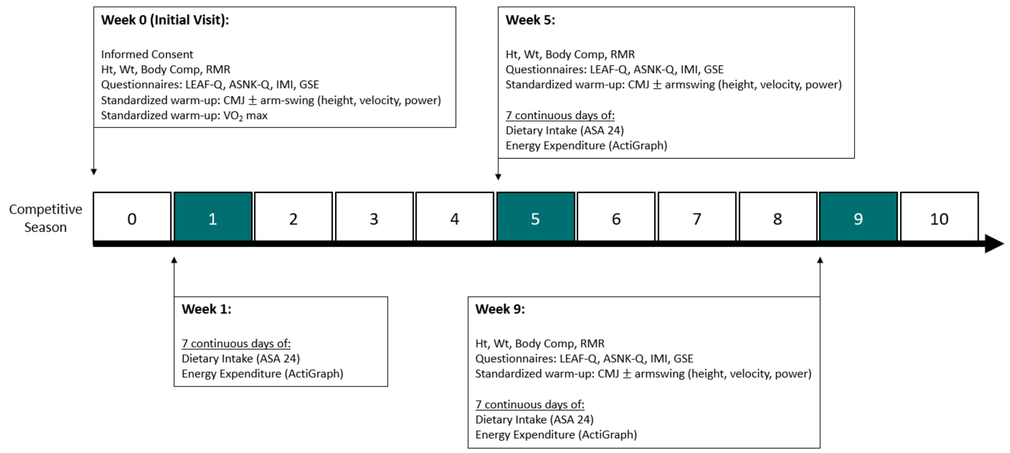
- Energy availability (EA) is the amount of dietary energy that remains after exercise and is available for other physiological functions (Torres-McGehee, 2021).
- Low-energy availability (LEA) occurs when energy intake, after subtracting active energy expenditure, is < 30 kcal/kg FFM/d and is the primary cause of the Female Athlete Triad and Relative Energy Deficiency in Sport.
- These conditions give rise to negative health outcomes in athletes such as increased risk of bone fractures, illness, poor reproductive health, and reduced metabolic rate, which are thought to correlate with decreased strength and endurance performance.
- The energetic demands of collegiate beach volleyball have been reported to be ~100-110 kcal/kg per week in exercise energy expenditure (Bozzini 2021).
- It has been reported that the average EA of beach volleyball athletes (N=18) was 12.44 kcal/kg FFM/d over seven days (Torres-McGehee 2021). This is well below the 30 kcal/kg FFM/d cut-off point defining LEA.



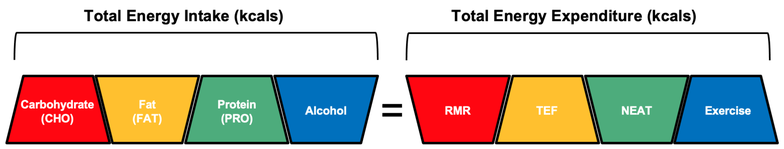
Purpose

The purpose of this study is to establish the current risk of LEA in female collegiate BVB athletes across the competitive season.

Experimental Protocol



Energy Balance Equation



ASA24 Automated Self-Administered 24-Hour Dietary Assessment Tool

Data Analysis

All variables were assessed for normality via Shapiro-Wilk's test.
Post-hoc analysis were completed with a Bonferroni adjustment to detect significance between individual time points.

Data are presented as Mean ± SD.
The threshold for significance will be accepted at p≤0.05.

Table 1. Paired Samples t-tests (N=10)

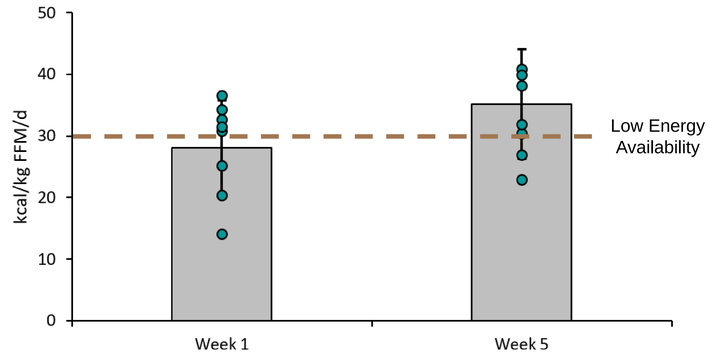
Anthropometrics and Performance			
	Week 1	Week 5	P-value
Weight (kg)	69.88 ± 7.37	69.81 ± 6.71	p=0.984
FM (%)	21.51 ± 3.76	20.17 ± 3.59	p=0.426
FFM (%)	78.49 ± 3.76	79.83 ± 3.59	p=0.426
CMJ without armswing (cm)	35.95 ± 5.26	37.54 ± 5.96	**p=0.043**
CMJ with armswing (cm)	44.05 ± 5.80	41.73 ± 7.61	**p=0.051**
ASNK-Q	19.30 ± 4.85	18.49 ± 2.72	p=0.515

Results

Table 2. Independent Samples t-tests

Energy Balance Equation				
Variable		Week 1 (N=8)	Week 5 (N=9)	p-value
Energy Intake	CHO (g)	289.98 ± 56.90	302.89 ± 48.97	p=0.622
	FAT (g)	107.77 ± 24.89	107.22 ± 17.76	p=0.959
	PRO (g)	108.53 ± 21.69	105.11 ± 26.88	p=0.779
	Total (kcals)	2552.38 ± 432.16	2592.00 ± 411.09	p=0.849
Energy Expenditure	RMR (kcals)	1612.60 ± 96.03	1652.50 ± 118.57	p=0.268
	TEF (kcals)	248.32 ± 45.46	259.20 ± 41.10	p=0.602
	Physical Activity (kcals)	794.13 ± 149.74	639.67 ± 154.73	**p=0.055**
Energy Availability (kcal/kg FFM)		28.13 ± 7.67	35.13 ± 8.90	p=0.114

Energy Availability



Discussion

The threshold for LEA is 30 kcal/kg FFM/d. While there was no statistical difference from Weeks 1 to 5, energy availability was physiologically and meaningfully improved during this time. Energy availability at Week 1 was below the threshold for LEA, while energy availability at Week 5 was above this threshold. The risk for LEA was present among the participants at Week 1, however as the season progressed energy availability improved.

References

1. Torres-McGehee TM, Emerson DM, Pritchett K, Moore EM, Smith AB, Uriegas NA. Energy Availability with or without Eating Disorder Risk in Collegiate Female Athletes and Performing Artists. *J Athl Train* 56: 993–1002, 2021. doi: 10.4085/JAT0502-20.
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