A Longitudinal Analysis of Dietary Intake in Comparison with Dietary Recommendations for Athletes

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ABSTRACT

Background: Little is known about dietary intakes, food habits, and overall diet quality over a competitive year in female endurance runners. The idea of periodizing the diet is relatively new and under researched. This study sought to describe athlete's periodization of their nutrition across a competitive year relative to the nutrients of concern. **Objectives:** Examine the nutritional adequacy of dietary intake (specifically energy intake (EI), energy availability (EA), macronutrients, vitamin D, calcium, and iron) in female collegiate runners across a competitive year. **Methods:** This longitudinal study included 3 lab visits with female distance runners over a competitive year (visit 1 being pre-training, visit 2 mid-training, and visit 3 post race/event). Each lab visit included anthropometry, dual x-ray absorptiometry (iDXA), a modified activity questionnaire (MAQ), a three-day food record, and Vioscreen food frequency questionnaire (FFQ). Dietary intake was measured using an average of nutrients in the food record (evaluated in ESHA) and the Vioscreen FFQ. Statistical analysis was run using the Wilcoxon Paired Sign Rank test and Proc Glimmix linear model. **Results:** The final study included 9 runners with complete nutritional data for 7 athletes ages 20-25 with an average weight and height of 55.02 ± 4.7 kg and 162.4 ± 5 cm, respectively. Average (mean) weekly mileage of 38.7 ±10.7, 35 ± 12.5 and 46.1 ± 19.6 across the visits. EI (mean) was 2,069 ± 332.5, 1,748 ± 318, and 1,806 ± 332 calories at visits 1-3 respectively. EA decreased with increasing mileage from 35.7 ± 9.3, to 31 ± 9.5, and 30.3 ± 10.7 kcal/kg*Fat Free Mass (FFM) (p=0.0001). All participants with the exception of one fell under the recommended threshold of having optimal EA (>45), with the majority (n=4) falling right at or below an EA of 30 kcal/kg*FFM. Few participants met sport-specific dietary recommendations for EI, carbohydrate, iron, and vitamin D regardless of training timepoint. **Conclusions:** Many runners failed to meet the proposed dietary guidelines for sport. This sample of female endurance runners did not appear to periodize their diet accompanying periodized training plans, which may negatively impact their injury risk and long-term health.

BACKGROUND

The number of females participating in running sports continues to grow, especially since the passing of Title IX. In 2018, there were 15,632 cross country runners. Despite the dramatic increase in women competing in college running sports and the importance of nutrition for health and performance, little is known about dietary intakes, food habits, whether they periodize the diet, and overall diet quality in this unique population. The American College of Sports Medicine (ACSM), Academy of Nutrition and Dietetics (AND), and Dietitians of Canada (DC) have created guidelines for athletes to follow to prevent disordered eating patterns and to heighten performance. This study seeks to analyze the current diets of female runners across a competitive year and compare findings to the current guidelines for sport.

METHODS.

Participants: upperclass collegiate female runners and collegiate aged female runners (20-26 years old) running at least 35 miles per week.
Assessments: FFQ, 3-day food record, anthropometrics, body composition and bone mineral density scan (iDXA), and questionnaires including injury history, menstrual history, modifiable activity questionnaire (MAQ), eating disorder examination questionnaire (EDE-Q), and perceived stress scale. The collegiate athletes were assessed pre-cross-country season (August 2018), post-cross-country season (November 2018), post-track season (May 2019), and encouraged to do a year follow-up in August 2019. The non-collegiate runners were first assessed in January 2019, with additional visits roughly May 2019, and October/November/December 2019 depending on competition and availability.

RESULTS

n=9	Mean	Stand Dev.	Min	Max
Age (years)	22.67	1.6	20	25
Weight (kg)	55.02	4.66	45.6	61.2
Height (cm)	162.4	4.98	152.4	168.9
BMI (kg/m^2)	20.9	1.88	17.8	24
Mileage (miles per week)	38.67	10.7	27	60
Reported Pace (min/mile)	7.8	.67	7:00	9:00

Table 1: Demographics

	Visit 1 (n=9)	Visit 2 (n=9)	Visit 3 (n=7)
EA<30	4	3	3
EA 30-45	4	6	4
EA>45	1	0	0
Carb>6g/kg	2	1	0
Pro>1.2 g/kg	6	5	5
Pro>1.5 g/kg	3	3	2
Pro>1.8 g/kg	1	1	1

Table 2: Frequency Values per Visit

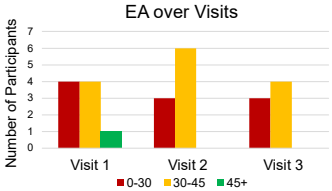

Figure 1: Subjects Meeting EA Guidelines

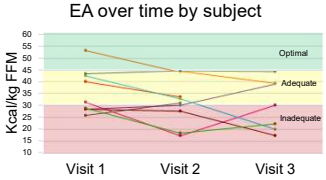

Figure 2: EA over Time

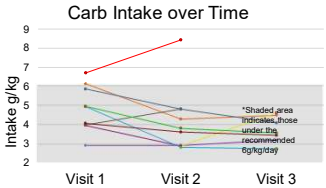

Figure 3: Carb Intake over Time

	Visit 1 Mean (SD)	Visit 2 Mean (SD)	Visit 3 Mean (SD)	RDA
Iron (mg)	42.7 (49.5)	43.4 (49.4)	42.5 (54.2)	18 mg/d
Calcium (mg)	1428.8 (368.8)	1283.4 (523.9)	1131.3 (347.2)	1,000 mg/d
Vitamin D (IU)	508 (538.5)	685.9 (804.1)	878 (887.4)	600 IU

Table 3: Micronutrients over Visits with RDAs

RESULTS

- **EA:** The mean EA decreased over time, with the mean of the first visit being 35.7 ± 9.3, followed by 31 ± 9.5 and the lowest at the third visit with a mean of 30.3 ± 10.7 kcal/kg FFM. Figure 1 displays that the majority of the participants were under the recommended threshold for EA of 30. As mileage increased, EA significantly decreased (p=.0001), producing a negative slope of -0.63 in the Proc Glimmix model.
- **Carbohydrate:** Only two participants in the first visit and one in the second visit met the minimum requirement of 6g/kg/day, with 7 athletes failing to do so (Figure 2). When comparing carbohydrate intake over time (days) we found it to have a p-value of 0.0625 with an estimate of -0.14, trending downward over time.
- **Protein:** Protein intake remained relatively constant over visits. Sixty-seven percent (6) of participants exceeded the minimum protein requirement for the first visits, while only 5 achieved this over visit 2 and 3 (Table 2). Only 1 person per visit consumed more over the upper end of the recommendations of 1.8 g/kg.
- **Fat:** All athletes consumed over the minimum recommendation of 20% total energy from fat. By the third visit all of the athletes consumed over 30% total energy from fat.
- **Micronutrients:** The average intakes per visit were greater than the RDA for all visits except vitamin D at the first visit (Table 3). Supplementation of the nutrients was included in the means.

CONCLUSION

This study demonstrated that female endurance runners are failing to meet current athlete recommendations when it comes to total energy, carbohydrate, and protein, and that it may be difficult to consume adequate micronutrients through food alone. This sample also did not appear to periodize their diet accompanying periodized training plans, which may negatively impact their injury risk and long-term health.
Limitations: Small sample size with no comparison group, high demands of the participants, poor follow-through, each participant being at a different point in their training and mileage, and using subjective and self-reported measures.
Future Studies: Subjects with equal skill level and training schedule, equally spaced out visits, and longer time frame. To further study periodization, creating surveys to investigate whether athletes alter their diet based on training would help gauge the athlete's attitudes and knowledge towards diet and training.