Nutrition, Body Composition, and Performance: A Case Study of Two Collegiate Wrestlers

Case Study

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Abstract

Introduction: This case-study examined changes in nutrient intake, body composition, and performance of two Division I wrestlers before and after competition season.

Methods: Two male wrestlers were assessed during pre-season (PRE) and after the national championship tournament (POST). Body composition was determined via 7-site skinfolds to estimate body fat percent (BF%) and fat-free mass (FFM). Nutrient intake was analyzed from 3-day food recalls. A Biodex dynamometer assessed isometric strength. A stationary cycle ergometer was used to assess anaerobic time to exhaustion (TTE).

Results: Both wrestlers' body mass and BF% increased at POST, while Participant 2's FFM decreased 0.9kg. Participant 2 met 44% and 67% of energy recommendations PRE and POST, respectively. Carbohydrate intake was approximately at 33% and 57% recommendations PRE and POST, while protein intake was at 75% of estimated needs. Participant 1 maintained performance from PRE to POST, while Participant 2 experienced a -15.0 and -5.0 $Nm \cdot kg^{-1}$ decrease in extension and flexion strength, respectively.

Conclusions: For these two athletes, under consuming energy and macronutrients seems to have a negative effect on muscle mass and strength performance, with less impact on anaerobic performance. These findings may provide insight for monitoring nutrition throughout the wrestling season to prevent decreases in strength and FFM.

Key Words: diet quality, sports nutrition, athletics.

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Introduction

Despite the critical importance of nutrient intake for weight class sports, few studies examine the intake of wrestlers, particularly throughout the season. However, Lingor and Olson[1] found that Division III wrestlers are in an energy deficit of approximately 1,000 kcal below their estimated needs during the competition season. To our knowledge, this is the only examination of nutrient intake of collegiate wrestlers during the competition season. Additionally, while previous reports examine performance and body composition changes throughout the season,[2–5] none evaluate these three aspects concurrently. Therefore, the purpose of this study was to examine individual changes in dietary intake, body composition, and performance at PRE and POST season of two Division I collegiate wrestlers.

Methods

Participants

Division I collegiate wrestlers (n=2) from a top fifteen team participated in this study. Participants were recruited at the end of their pre-season training cycle (six days per week for ~two hours per day), with a larger focus on resistance

training and aerobic exercise. In season training included a combination of anaerobic and aerobic training, as well as technical wrestling skill, with less emphasis on strength training. Both participants signed a written informed consent prior to data collection. This study was approved by the university Institutional Review Board (approval #2209012-EXP).

Protocol

This study was a case-study design of two collegiate wrestlers examining changes in nutrient intake, body composition, and performance at pre- and post-season. Two separate experimental visits were conducted during the wrestlers' pre-season within seven days prior to the start of competition season (late September- early October) (PRE) and within seven days after the completion of the NCAA National Championship tournament (POST). Figure 1 displays the assessments performed at the experimental visits.

Figure 1. Study design. MVIC: maximal voluntary isometric contraction. Visit 1 and Visit 2 were separated by 4-7 days.

Prior to the first trial, participants completed a health status questionnaire, PAR-Q+[6] and a 3-day food recall. The 3-day food recall collected nutrient intake prior to each test visit. Participants were asked to record everything consumed in the three days leading up to each test visit. The research team, which included a Registered Dietitian, instructed participants on the proper way to complete the food record. The Registered Dietitian reviewed each completed 3-day recall and interviewed each athlete to more accurately gather information on portion sizes, preparation methods, and additional items consumed. Energy, macronutrient, and micronutrient intake were analyzed. During the first visit, height and weight were collected using a stadiometer, and digital scale (Seca gmbh & Co.kg Hamburg, Germany), respectively. Isometric torque of participants' right leg was measured using a Biodex System 4 Quick-Set isokinetic dynamometer (Biodex Medical Systems, Inc., Shirley, NY). During the first visit, maximum voluntary isometric contractions (MVIC) of the hamstring and quadriceps were assessed at a flexion angle of 60° below the horizontal plane. Each participant completed two warmup leg extension and leg flexion muscle actions at approximately 50% and 75% of perceived effort and one practice attempt of leg extension and flexion MVICs. Three, 4-second leg extension and flexion MVICs were then performed. Peak torque was recorded for the two highest values for extension and flexion. After approximately five minutes of rest, participants completed a graded exercise test on a calibrated cycle ergometer (Velatron®, SRAM LLC, Chicago, IL) to exhaustion. Each participants' maximal power (W_{max}) was recorded as the maximum power output measured during the final stage of the protocol.[7] This value was used to conduct the anaerobic exhaustion protocol on the second test visit.

During the second visit, body composition was gathered using skinfold measurements taken with a Lange caliper (Model 68902, Cambridge Scientific Industries, Inc, Cambridge, MD) on the right side of the body, utilizing male 7-site skinfolds of the chest, midaxillary, triceps, subscapular, abdomen, suprailiac, and thigh. Each skinfold measurement was taken twice at each site and a third measurement was taken if the difference exceeded two mm. The average of two measurements within two mm was recorded. Recorded measurements were used to calculate body density[8] and estimate fat mass (FM) (kg), Fat-free mass (FFM) (kg), and Body fat percent (BF%).[9] FFM estimates were then used to estimate resting metabolic rate (kcals) using the Cunningham Equation.[10] An activity factor of 1.8 was used to estimate total energy expenditure (eTEE). This activity factor was chosen based on the activities required of collegiate students, including walking on campus while carrying books/laptops, as well as an additional two-three hours of planned moderate-vigorous activity as collegiate athletes.[11]

$$Resting\ metabolic\ rate\ (Cunningham\ Equation) = 500 + 22(FFM)$$

Participants performed the anaerobic exhaustion protocol, including a five-minute warmup at 100 W, five minutes of rest, and then incremental increases in intensity with 15 seconds at 80% W_{max}, 15 seconds at 95% W_{max}, and then 110%

W_{max} until volitional exhaustion was reached. Participants were instructed to pedal at a self-selected, constant pace. The test was stopped when the participant's pace dropped by 20 RPMs. Time to exhaustion (TTE, s) was recorded.[12]

After PRE testing, participants were engaged in an approximately 20-week competition season. There were 25 competitions, including the National Championship tournament, within the season. POST testing was administered within four weeks following the conclusion of the National Championship tournament and was identical to the two PRE testing visits.

Statistical Analysis

Means of the three-day recall values for energy, macronutrients, and micronutrients and body composition and performance values were reported and normalized to kg body mass. Differences between values at PRE and POST were calculated in a spreadsheet software program (Microsoft Excel 2022, version 2208). Energy and macronutrient intakes were compared to recommendations and %RDAs were calculated for micronutrients.

Results

Two collegiate wrestlers were individually examined for this study. Participant 1 was 23 years old, 167 cm, and had 19 years of wrestling experience. Participant 2 was 23 years old, 168 cm, and had 18 years of wrestling experience. Table 1 reports the energy, macronutrient, and micronutrient intake, body composition, and performance metrics of both participants at PRE and POST. In general, both participants increased energy and micronutrient intake, with varying differences in macronutrient intake. Both participants BF% and overall weight increased, while participant 2 had a decrease in FFM.

Figure 2 reports the energy and macronutrient intake per kg body weight ($g \cdot kg^{-1}$) of each participant PRE and POST. Participant 1 met or exceeded recommendations except for protein. Participant 2 was below recommendations, in general. Diet composition varied between both wrestlers, but the energy and fat intake of each participant increased at the POST timepoint.

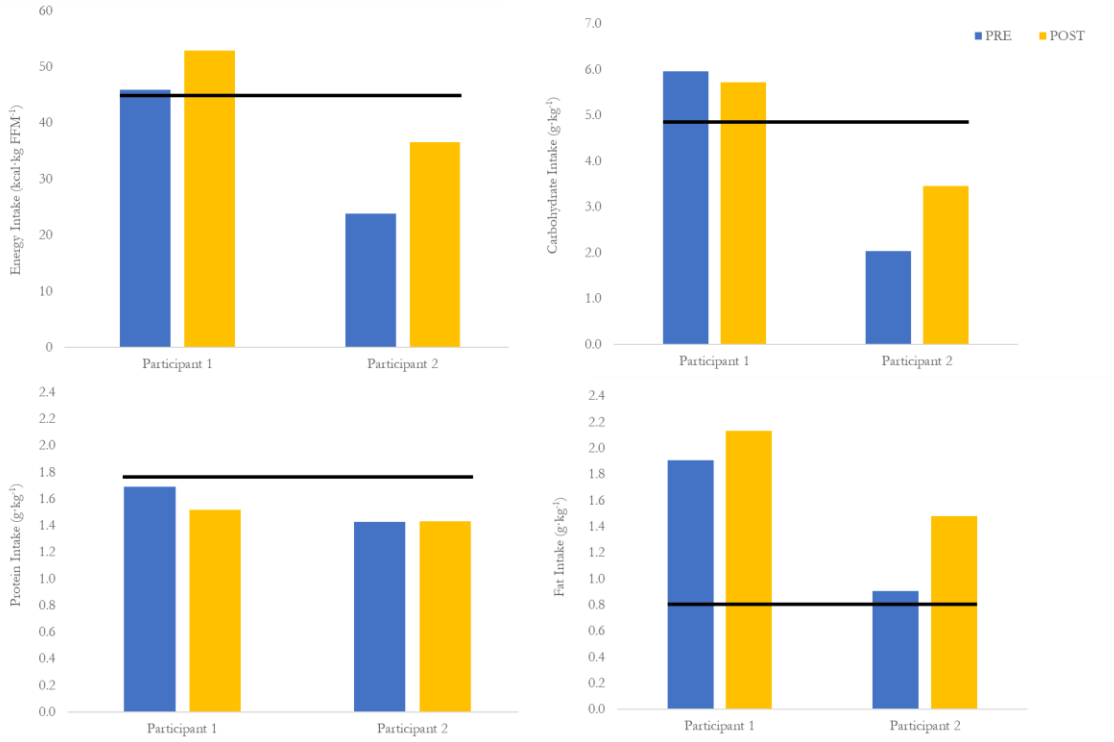

Figure 2. Relative energy and macronutrient intake ($g \cdot kg^{-1}$) of both participants at PRE and POST competition season. The black bars represent recommended values ($g \cdot kg^{-1}$) as recommended by Thomas et al.[13]

Table 1. Body composition, performance, and energy, macronutrient, and micronutrient intake and comparisons to recommendations in two collegiate wrestlers at PRE and POST competition season. Value change (Δ) and Percent Recommended Dietary Allowances (%RDA) were calculated to show change from PRE to POST and how intake compared to recommendations at both PRE and POST.

	Participant 1					Participant 2				
Body Composition	**PRE**		**POST**		**Δ**	**PRE**		**POST**		**Δ**
Above Competition Weight (kg)	5.9		9.3		3.4	7.7		9.0		1.3
Fat-Free Mass (kg)	66.6		68.1		1.5	61.7		60.8		-0.9
Fat Mass (kg)	3.2		5.1		1.9	2.7		4.9		2.2
Body Fat Percent (%)	4.5		6.9		2.4	4.2		7.5		3.3
Performance	**PRE**		**POST**		**Δ**	**PRE**		**POST**		**Δ**
Extension Peak Torque ($Nm \cdot kg^{-1}$)	202.7		202.6		-0.1	232.5		217.5		-15.0
Flexion Peak Torque ($Nm \cdot kg^{-1}$)	124.6		138.2		13.6	100.6		95.6		-5.0
Time to Exhaustion (s)	74.0		79.0		5.0	78.0		149		71.0
Energy and Macronutrients	**PRE**	**Recommendation**	**POST**	**Recommendation**	**Δ**	**PRE**	**Recommendation**	**POST**	**Recommendation**	**Δ**
Energy (kcal)	3055	3,538[a]	3600	3,597[a]	545	1466	3,342[a]	2221	3,306[a]	755
Carbohydrates (g)	416	349 – 489[b]	419	366 – 512[b]	3	131	322 – 451[b]	227	329 – 460[b]	96
Protein (g)	118	126 – 140[c]	111	132 – 146[c]	-5	92	116 – 129[c]	94	118 – 131[c]	2
Fat (g)	133	70[d]	156	73[d]	23	58	64[d]	97	66[d]	39

Micronutrients [c]	PRE	% RDA	POST	% RDA	Δ	PRE	% RDA	POST	% RDA	Δ
Vitamin A (μg)	123	14%	1398	155%	1275	110	12%	507	56%	397
Vitamin D (IU)	297	50%	387	65%	90	42	7%	95	16%	53
Folate (mg)	340	85%	510	128%	170	320	80%	370	93%	50
Calcium (mg)	1200	120%	1540	154%	340	292	29%	990	99%	698
Iron (mg)	24	300%	19	238%	-5	12	150%	10	125%	-2
Potassium (mg)	3294	97%	3557	105%	263	2796	82%	1930	57%	-866
Sodium (mg)	4844	210%	5105	222%	261	1410	61%	3822	166%	2412

[a] Calculated using the Cunningham Equation and an activity factor (AF) of 1.8;[10] [b] Carbohydrate recommendation of 5 – 7 $g \cdot kg^{-1}$;[13] [c] Protein recommendation of 1.8 – 2.0 $g \cdot kg^{-1}$;[13] [d] Fat recommendation of 1.0 $g \cdot kg^{-1}$;[13] [e] Micronutrients were compared to Recommended Dietary Allowances (RDA)[14]

Discussion

This study examined two D1 collegiate wrestlers before and after their competition season. The two wrestlers were 5.9 kg and 7.7 kg, respectively, above their competition weight at PRE. Both regained weight after the season was completed, each weighing approximately 9 kg above their respective competition weight. Additionally, both wrestlers experienced an approximately 3% gain in body fat at POST, which is commonly seen among wrestlers.[4,5] Most wrestlers utilize the preseason to decrease FM, with the goal of maintaining FFM in order to be closer to their competition weight throughout the season.[1] After the season, a rebound effect is seen with wrestlers regaining body fat.[4,5] FFM increased in Participant 1 but decreased slightly in Participant 2, which may be related to underconsumption in energy, protein, and carbohydrate intake. Overall, Participant 1 maintained performance from PRE to POST, whereas Participant 2 had a decrease in strength while increasing anaerobic performance (TTE) (Table 1). While there could be multiple factors influencing these performance outcomes over a wrestling season (including wrestling and competition experience, recovery ability, mental fortitude), it is possible that Participant 1's maintenance of FFM and performance measures was partially influenced by his intake nearly meeting recommendations, compared to Participant 2 whose intake of energy, carbohydrate, and protein was much lower than recommendations (Table 1, Figure 2). However, it is likely that dietary intake is just one characteristic affecting performance in wrestling and should be monitored in conjunction with other performance and recovery metrics. Both wrestlers followed the same training program throughout the season; however, Participant 1 was an upperclassman compared to Participant 2 who was an underclassman, indicating that training and competition experience at this level may have been influential to performance. Additionally, there may be other individual factors affecting the variability in performance that were not assessed in the current study including metabolic differences, effort during training, prevalence of illness, and sleep habits that could have been contributory.

For micronutrients, both Participant 1 and 2 increased dietary intakes of all vitamins and minerals except iron from PRE to POST and potassium for Participant 2. Participant 1 was only below the RDA for vitamin A, vitamin D, and folate at PRE and only vitamin D at post. In comparison, Participant 2 was below RDA for vitamin A, vitamin D, folate, calcium, and potassium PRE and POST and sodium at PRE. There is emerging evidence to support the role of vitamin D on skeletal muscle function, and thus, athletic performance, indicating that deficient intake in this vitamin could adversely affect performance, yet intake is commonly low in athletes.[15-17] Calcium has multiple functions importance for athletic performance including maintaining bone health, supporting muscle contraction, and nerve conduction.[18] Additionally, with the particular emphasis wrestling may have on hydration techniques to make weight, electrolyte intake, such as potassium, warrants consideration for appropriate fluid balance for health and performance.[18] This suggests potential micronutrients to monitor in wrestlers.

Wrestlers experience a high amount of physiological stress due to high training load that includes both aerobic and anaerobic training, in addition to stress with dieting during pre-season to be close to competition weight. Although chronic energy deficiency, as may be seen from the weight regulation practices of wrestlers, can negatively impact performance and metabolic homeostasis,[19] there is evidence that rapid weight loss techniques may be harmless in the short term.[20] However, likely due to lack of information, there are currently no recommendations for optimal strategies for wrestlers to balance weight maintenance, general health, and performance. While previous studies have examined body weight and composition, hydration, and performance, there is a lack of research on nutritional intake at different phases of the wrestling season.[3–5] Since wrestling involves high physiological stress, meeting sufficient nutritional needs is necessary to maintain performance and health, while still achieving competition weight. Monitoring nutrition at different phases of the wrestling season can provide insight on areas for improvement and lead to recommendations for nutritional strategies during the pre-season weight cut.

Strengths and Limitations

Strengths of this study include a novel, well-rounded assessment of high-level wrestlers before and after competition, including an in-depth dietary analysis and comparisons to recommendations, body composition assessment, and strength and anaerobic tests of performance. With wrestling being a highly individualized sport, this provides some context on how nutritional intake may differ among wrestlers and potentially have some contribution to body composition and/or performance. Limitations of this study include the fact that this is a case study following n=2 wrestlers, which limits the generalizability of these findings to other wrestlers and/or populations. However, this does provide some insight to sports dietitians working with wrestling on potential nutrients to monitor. Additionally, the use of 3-day recalls also has some limitations including self-report bias and potential error with portion sizes. The researchers tried to limit this potential error by interviewing the participants over the 3-day recall and providing visuals to help with portion size estimations.

Conclusions

In conclusion, overall nutrient intake and body mass increased after the competition season for these two wrestlers. For Participant 1, who was meeting, or close to meeting, nutrient intake recommendations, changes in intake and body composition after a competition season did not seem to impact performance. However, for Participant 2, whose dietary intake was generally below recommendations even with an increase from PRE to POST, body fat increased while FFM decreased, and he experienced a decrease in isometric strength and increase in anaerobic TTE. While this is a case study of two individual wrestlers and cannot be generalized to a broader population of wrestlers or athletes, Participant 1 meeting energy and macronutrient needs may have potentially contributed to maintenance of FFM and strength over the competition season. More research is needed on a larger-scale to determine further nutrition recommendations for the wrestling season. Establishing an appropriate, long-term nutrition and weight cut strategy may help wrestlers keep dietary intake closer to recommendations, and thus, may have a positive effect on maintaining body composition and performance. While not generalizable to all wrestlers, these findings may provide insight on nutritional trends that may influence performance and body composition in this sport, particularly being a weight class sport.

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