Journal of Sports Science 5 (2017) 189-197
doi: 10.17265/2332-7839/2017.04.001

Body Composition and Performance Capabilities Based on Protein Intake in Collegiate Dancers: A Pilot Study

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Abstract: The aesthetic nature of dance places pressure on the athlete to have low body weight and fat and despite data showing higher protein intake improving body composition in numerous populations, a paucity of data exists on dancers. Therefore, the purpose of this study was to examine associations between protein intake, body composition and performance among dancers. Female dancers (n = 25; age 20.7 ± 1.8 years; mean ± SD) completed three-day diet logs, body composition (DXA), and performance testing. Protein intake was expressed as g/kg/day and three equal tertiles were created (Low protein: LP, < 1.2 g/kg/day; Moderate protein: MP, 1.2-1.6 g/kg/day; High protein: HP, > 1.6 g/kg/day). Data were analyzed using one-way ANOVA to compare group means with significance at $P < 0.05$. Protein and energy intake were greater in HP compared to LP (P = 0.001, 0.033, respectively). The only performance difference observed was peak horizontal force (AMTI force platform) which was significantly greater in HP compared to LP (LP: 295.7 ± 111.1N, HP: 419.9 ± 76.7N; P = 0.029). In conclusion, no significant differences were found between protein tertiles and body composition. Nevertheless, protein intake may be physiologically important to dancers when combined with evidence from other athletic populations indicating high protein and energy intake may be beneficial to body composition.

Key words: Body composition, nutrition, protein, performance, dance.

1. Introduction

Aesthetic sports place a high demand on athletes to maintain a lean physique, in particular low body weight and fat, which often leads to severe calorie restriction [1]. In addition to achieving a lean figure there is also an expectation to optimize performance and the athlete's power-to-weight ratio. In athletic events which require horizontal or vertical movements such as long jump or figure skating, excessive mass is considered a disadvantage [1]. Although dance is a performing art by nature, the physiological demands suggest dancers are athletes as well as artists. Dance requires technical skill, strength, and endurance, all of which place great demands on the dancer [2]. In order to meet these demands while maintaining the necessary aesthetic, optimal nutrition is of primary importance [2].

Dance and other aesthetic sports (gymnastics, figure skating, diving, etc.) that foster a pressure to maintain a low body weight have been associated with increased risk of developing disordered eating or clinical eating disorders [3, 4]. Consequences of long term energy restriction and weight fluctuation include nutrient deficiencies, chronic fatigue, and increased risk of injury, all which have the potential to hinder performance and negatively impact health [5]. In order to achieve a lean figure and improve body composition,

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researchers have investigated higher protein diets as a way to attenuate lean mass loss in athletes during caloric restriction [6-8]. Additionally, it is suggested that in order to maximally attenuate lean mass, protein needs are increased further if athletes follow an energy-restricted diet [8, 9]. In order to attenuate lean body mass loss during energy restriction protein requirements may be as high as 1.8-2.7 g/kg/day [8].

High protein intake has been investigated in a variety of athletes [10-12], but little research exists in regards to protein intake and dancers [4, 13]. The current nutrient recommendations for dancers are 3-5 g carbohydrate/kg/day, 1.2-1.7 g protein/kg/day, and 20%-35% total energy from fat [14]. Adolescent female dancers have been reported to consume on average 1.6 g/kg/day protein, however 23% consume less than 1.2 g/kg/day [13]. Despite these values being higher than the current RDA for protein (0.8 g/kg/day), they are still below what is recommended (1.8-2.7 g/kg/day) for athletes needing to maintain lean mass during weight loss [8]. The relationship between protein intake, body composition and performance has not been investigated in female dancers. Therefore, the purpose of this study was to examine the relationship between tertiles of protein intake and both body composition and performance in female collegiate dancers.

2. Materials and Methods

2.1 Participants

Thirty collegiate female dancers, age 18 to 28 years, were recruited to participate in this study. All dancers had a minimum of 8 years of dance training (at least 6 hr/week). Dancers were recruited from local dance studios and the Florida State University School of Dance. Additionally, participants were non-smoking and free of significant musculoskeletal injuries for at least 6 months. Participants had no contraindications to exercise based on the American College of Sports Medicine (ACSM) and American Heart Association (AHA) established criteria [15, 16]. Participants were fully informed of the study purpose and experimental protocol as well as the potential risks and benefits associated with the study prior to giving written consent. The Florida State University Institutional Review Board approved all procedures.

2.2 Food Intake and Protein Tertile Determination

Participants visited the Institute of Sports Sciences & Medicine (ISSM) laboratory on two different occasions in the afternoon (1400-1800 hr). Dietary records were distributed on the initial visit and collected on the second visit for analysis (Food Processor, 10.13.1, Salem, OR). Participants were instructed to maintain habitual eating patterns and record dietary intake over three consecutive days, two weekdays and one weekend day. Record keeping included detailed descriptions of all food and drink consumed. Participants submitted food photographs to assist with serving size determination. Protein tertiles were determined by SPSS analysis using equal cut points of protein intake (g/kg/day; Low protein: LP < 1.2 g/kg/day, n = 8; Moderate protein: MP 1.2-1.6 g/kg/day, n = 9; High protein: HP > 1.6 g/kg/day, n = 8).

2.3 Anthropometry and Body Composition

During the initial visit height and weight were measured using a wall-mounted stadiometer (SECA 216, Hamburg, Germany) and a digital scale (DETECTO, Model 6127, Webb City, MO). Body composition was measured non-invasively using dual-energy x-ray absorptiometry (DXA; Hologic Inc., Discovery QDR Series, Bedford, MA, USA). One anteroposterior scan was performed by a certified x-ray technician according to the manufacturer’s instructions and specifications. Results were analyzed with APEX software, version 4.5.2.1 (Hologic Inc. Discovery QDR Series). The quality analysis for the densitometer was conducted daily using a standard aluminum spine block (Hologic Phantom) provided by the manufacturer. Measurements of the phantom were within the manufacturer's precision standard with a coefficient of variance < 0.5%. Test-retest interclass coefficient of variation (CV; %) using DXA for FM and LM (kg) were 1.3% and 0.8%, respectively. Lean and fat mass, appendicular skeletal muscle mass (ASM), appendicular skeletal muscle mass index (ASMI), and bone mineral density were used for analysis.

2.4 Performance Testing

The second visit to the laboratory was scheduled within six days of the initial visit to conduct a series of performance tests. Prior to the visit, participants were instructed to abstain from exercise for 24 hours, and consume a nutrition bar 2 hours before arrival (Nature Valley Chewy Protein Bar, Peanut Almond & Dark Chocolate, 190 calories, 12 g fat, 14 g carbohydrate, 10 g protein).

A five-minute self-paced warmup was completed prior to testing. In order to best simulate dance positions, lower body muscular endurance testing was measured by a wall sit for maximum time with hips externally rotated and 90° flexion at the knee (second position grande plié). Participants were instructed to cross their arms over their chest to avoid assistance by pressing against the wall. The test was terminated when the participant could no longer maintain 90° flexion or hip external rotation. Participants were given a three-minute rest period prior to the next test.

Participants performed a vertical jump test, using the VERTEC (Sports Imports, Inc., Columbus, OH, USA) vertical jump assessment tool. Participants were instructed to begin in a parallel, hip-width plié before each jump and the best of three attempts was recorded.

Participants then performed a grande jeté (large leap from one leg) on an AMTI force platform (Model BP600900, Advanced Mechanical Technology Inc., Watertown, MA) to measure force production during take-off. Each participant was asked to take three steps for preparation where the third step, using the dominant leg, initiated take-off. Participants were given two attempts and the greatest peak horizontal (F_y) and vertical (F_z) forces were used for analysis.

Lower-body anaerobic power was measured by the Wingate anaerobic power test. Adjustments were made to properly fit each participant on the Velotron DynaFit Pro cycle ergometer (RacerMate, Seattle, WA, USA). Participants were given a 20-second warmup followed by a five-second acceleration phase to achieve peak cadence. Following the acceleration phase, a load equal to 7.5% body weight was applied to the flywheel through the electronic braking system, and participants pedaled continuously for 30-seconds. Absolute and relative values for mean and peak power were recorded in addition to fatigue index (FI). Participants were given a five-minute rest interval upon completion.

Lower-body isokinetic strength of the dominant leg were determined using the Biodex System 3 (Biodex Medical Systems, Shirley NY, USA) exercise dynamometer. Each participant was seated in an upright position on the Biodex, where seat height and position were adjusted to align the instruments axis with the participant's knee. Once aligned correctly and secured, range of motion of the limb was determined. Five repetitions of consecutive maximal extension and flexion ($180^\circ s^{-1}$) tests were conducted followed by a 1-minute rest interval. A 50-repetition isokinetic unilateral knee extension/flexion test ($180^\circ s^{-1}$) was conducted and intended to fatigue the lower limb. FI was calculated by subtracting the mean of the final 3 repetitions by the mean of the first 3 repetitions, divided by mean of the first 3 repetitions multiplied by 100. The research team provided encouragement throughout all performance tests.

2.5 Statistical Analysis

Statistical analysis was completed by SPSS version 21.0 (SPSS Inc., Chicago, IL). Sample size was determined using an alpha level of 0.05. Three equal protein tertiles were statistically created after data collection (LP, < 1.2 g/kg/day, n = 8; MP, 1.2-1.6 g/kg/day, n = 9; HP, > 1.6 g/kg/day, n = 8). All data were analyzed using one-way analysis of variance

(ANOVA) to compare group means and Tukey post hoc testing was used to determine group differences. Significance was set at $P < 0.05$. All data are reported as mean ± SD. Supplemental analysis was completed using Cohen's D in order to qualitatively describe the between group effect size as small ($d = 0.2$), medium ($d = 0.5$), or large ($d = 0.8$).

3. Results and Analysis

3.1 Participants & Anthropometric Characteristics

Of the 30 participants originally enrolled, 25 dancers (20.9 ± 2.1 years; LP: n = 8; MP: n = 9; HP: n = 8) completed dietary logs, DXA scans and performance testing and thus were included in the final data analysis. Self-reported years of training were 15.3 ± 3.2 years. There were no significant differences in participant and anthropometric characteristics between groups (Table 1). The majority of participants were of healthy weight (BMI, 18.5-24.9 kg/m^2). One participant was overweight (BMI = 25.95 kg/m^2), and two participants were underweight (BMI < 18.5 kg/m^2). Four participants (16.0%) reported irregular menstrual periods.

3.2 Dietary Intake

Mean reported energy intake for all dancers was 2,208 ± 459 kcal/day (Table 2). Total energy intake was greater in HP compared to LP (HP: 2,440 ± 335 kcal/day; LP: 1,884 ± 500 kcal/day; $P = 0.033$, d = 1.29). Mean intake for carbohydrate and fat were not statistically different across groups ($P > 0.05$). Protein consumption (g/kg/day) was greater in MP vs. LP (P = 0.001, d = 2.944), HP vs. MP (P = 0.000, d = 2.275), and HP vs. LP (P = 0.000, d = 3.857). However, all eight participants in the LP group (32%) fell below the protein recommendation (1.2-1.7 g/kg/day) for dancers [14]. Additionally, 21 participants (84%) fell below the protein recommendation (1.8 g/kg/day) for athletes to maintain lean mass during weight loss [9]. Dietary fat consumption for 10 out of the 25 participants (40%) exceeded the current sports nutrition recommendation of 20-35% total calories from fat [17]. Total cholesterol intake was greater in MP than LP (P = 0.018, d = 1.123). The spread for protein intake (% and g/kg/day) between groups was calculated based on the mean protein intake for each group (Table 3).

3.3 Body Composition

There were no significant differences between LP, MP, and HP for all body composition measurements (P = 0.592-0.999, d = 0.007-0.461, Table 2). There were no significant differences between groups for ASM, ASMI, or BMD (P = 0.592-0.999, d = 0.023-0.246, Table 2).

3.4 Performance Characteristics

There were no significant differences observed between groups for all performance characteristics except for peak horizontal force measured using an AMTI force platform (F_y; Table 4). LP produced

Table 1 Participant characteristics by tertile of total protein intake (g/kg/day)[1].

Characteristics	Total (n = 25)	LP (n = 8)	MP (n = 9)	HP (n = 8)
Demographics				
Age	20.7 ± 1.8	21.5 ± 2.2	20.7 ± 1.7	20.0 ± 1.2
YOD	15.3 ± 3.0	15.9 ± 3.5	14.0 ± 3.9	15.8 ± 1.3
Anthropometrics				
Height (m)	1.7 ± 0.1	1.7 ± 0.1	1.7 ± 0.1	1.7 ± 0.1
Weight (kg)	58.2 ± 8.0	59.1 ± 8.2	59.4 ± 6.1	55.9 ± 10.2
BMI (kg/m^2)	21.0 ± 2.3	21.4 ± 2.6	21.2 ± 1.6	20.3 ± 2.9

[1]Mean ± SD.

YOD, years of dance; m, meters; kg, kilograms.

LP (low protein, < 1.2 g/kg); MP (moderate protein, 1.2-1.6 g/kg); HP (high protein, > 1.6 g/kg).

Table 2 Dietary intake & body composition by tertile of total protein intake (g/kg/day)[1].

Dietary Intake	Total (*n* = 25)	LP (*n* = 8)	MP (*n* = 9)	HP (*n* = 8)
Total Energy (kcal/day)	2,208 ± 459	1,884 ± 500	2,289 ± 373	2,440 ± 349^{+}
Carbohydrate				
kcal/day	1,143 ± 316	1,006 ± 312	1,197 ± 300	1,219 ± 332
g/day	286 ± 79	251 ± 78	299 ± 75	305 ± 83
% total energy intake	52 ± 10	54 ± 10	52 ± 8	50 ± 12
Protein				
kcal/day	331 ± 115	220 ± 37*	331 ± 44$^{\#}$	443 ± 116^{+}
g/day	83 ± 29	55 ± 9*	83 ± 11$^{\#}$	111 ± 29^{+}
g/kg/day	1.4 ± 0.5	0.9 ± 0.2*	1.4 ± 0.1$^{\#}$	2.0 ± 0.3^{+}
% total energy intake	15 ± 4	12 ± 3	15 ± 3	18 ± 5^{+}
Fat				
kcal/day	745 ± 235	622 ± 239	775 ± 174	833 ± 265
g/day	83 ± 26	69 ± 27	86 ± 19	93 ± 30
% total energy intake	33 ± 7	32 ± 5	34 ± 6	34 ± 10
Cholesterol (mg)	243 ± 181	113 ± 85*	313 ± 237	296 ± 107
Body Composition	**Total (*n* = 25)**	**LP (*n* = 8)**	**MP (*n* = 9)**	**HP (*n* = 8)**
Total body weight (kg)	58.2 ± 8.0	59.1 ± 8.2	59.4 ± 6.1	55.9 ± 10.2
Fat Mass				
kg body weight	15.3 ± 4.2	16.2 ± 3.9	15.3 ± 3.3	14.3 ± 5.4
% total body weight	26.2 ± 4.5	27.4 ± 4.0	26.1 ± 3.4	25.1 ± 6.0
Lean Mass				
kg body weight	40.0 ± 4.5	40.2 ± 5.1	40.9 ± 3.1	38.9 ± 5.4
% total body weight	70.1 ± 4.5	68.9 ± 3.9	70.6 ± 3.8	70.9 ± 5.8
ASM (kg)	18.7 ± 2.4	19.0 ± 2.6	18.9 ± 1.9	18.3 ± 3.0
ASMI (kg/m^2)	6.5 ± 0.7	6.7 ± 0.8	6.6 ± 0.5	6.3 ± 0.8
BMD (g/cm^2)	1.1 ± 0.7	1.1 ± 0.1	1.1 ± 0.1	1.11± 0.1

[1]Mean ± SD (all such values).

Kcal, kilocalorie; g, grams.

LP (low protein, < 1.2 g/kg); MP (moderate protein, 1.2-1.6 g/kg); HP (high protein, > 1.6 g/kg); * indicates significant differences ($P \leq 0.05$) between LP and MP; $^{\#}$ indicates significant difference ($P \leq 0.05$) between MP and HP; $^{+}$ indicates significant differences ($P \leq 0.05$) between LP and HP. ASM, Appendicular Skeletal Muscle; ASMI, Appendicular Skeletal Muscle Index; BMD, Bone Mineral Density.

Table 3 Protein spread theory[1].

Difference Between Tertiles		
Groups	(%)	(g/kg/day)
LP:MP	36	0.5
MP:HP	26	0.6
LP:HP	53	1.1

[1]Adapted from Bosse & Dixon, 2012.

LP (low protein, < 1.2 g/kg); MP (moderate protein, 1.2-1.6 g/kg); HP (high protein, > 1.6 g/kg).

Table 4 Performance characteristics by tertile of total protein intake (g/kg/day)[1]

Performance Measurement	Total (*n* = 25)	LP (*n* = 8)	MP (*n* = 9)	HP (*n* = 8)
Wall-sit duration (s)	145.6 ± 63.1	156.0 ± 92.9	140.7 ± 40.9	140.7 ± 54.0
Vertical jump (cm)	37.1 ± 6.0	35.6 ± 5.3	38.0 ± 7.5	37.7 ± 5.3
Peak horizontal force (Nwts)	362.0 ± 100.1	295.7 ± 111.1	369.6 ± 79.3	419.9 ± 76.7^{+}
Peak vertical force (Nwts)	1,651.7 ± 259.4	1,582.0 ± 288.9	1,708.6 ± 193.8	1,647.0 ± 259.4
Mean anaerobic power (W)	426.5 ± 67.6	422.3 ± 60.0	426.4 ± 67.9	430.8 ± 82.5
Relative mean anaerobic power ($W \cdot kg^{-1}$)	7.3 ± 1.0	7.1 ± 1.2	7.1 ± 1.2	7.7 ± 0.6
Peak anaerobic power (W)	692.4 ± 114.2	715.3 ± 106.6	689.9 ± 98.2	672.3 ± 145.9
Relative peak anaerobic power ($W \cdot kg^{-1}$)	11.8 ± 1.3	12.0 ± 1.4	11.5 ± 1.2	11.9 ± 1.2
Peak Extension Torque ($N \cdot m$)	88.1 ± 14.0	86.0 ± 17.9	88.8 ± 12.6	89.3 ± 12.9
Peak Flexion Torque ($N \cdot m$)	62.0 ± 12.0	64.5 ± 15.7	63.0 ± 11.7	58.3 ± 7.9
Fatigue Index (%)	45.5 ± 11.9	44.7 ± 17.4	43.8 ± 9.5	48.3 ± 8.0

[1]Mean ± SD (all such values).

s, seconds; cm, centimeter; Nwts, Newtons; W, watts; kg, kilogram; m meters.

LP (low protein, < 1.2 g/kg); MP (moderate protein, 1.2-1.6 g/kg); HP (high protein, >1.6 g/kg); * indicates significant differences ($P \leq 0.05$) between LP and MP; $^{\#}$ indicates significant difference ($P \leq 0.05$) between MP and HP; $^{+}$ indicates significant differences ($P \leq 0.05$) between LP and HP.

significantly less horizontal force (295.7 ± 111.1N) compared to HP (419.9 ± 76.7N; $P = 0.029$, $d = 1.301$) during grand jeté performance testing. When normalized for total body weight (kg), both mean and peak anaerobic power remained too similar to detect differences between groups.

4. Discussion

To our knowledge, this is the first study to investigate the associations between level of protein intake, body composition and performance in female dancers. Due to the paucity of data on dancer-specific nutrition recommendations, dietary intake of the current sample of dancers will be compared with other aesthetic athletes [18]. The majority of dancers (93.0%) in the present study were of healthy body weight and BMI. Data found that only 16.0% of the dancers in this study consumed the recommended amount of dietary protein for maintaining lean mass in an athletic population maintaining low body weight [9]. Diet log analysis also indicated average dietary fat (32 ± 5%, 34 ± 6%, 34 ± 10% total calories) and carbohydrate intake (54 ± 10%, 52 ± 8%, 50 ± 12% total calories) in LP, MP, and HP, respectively, fell within the Acceptable Macronutrient Distribution Range [16].

Exogenous protein is required in the diet for the maintenance of muscle protein balance. Protein requirements are increased for athletes due to increased activity level, which elevates muscle protein breakdown. To attenuate muscle protein loss, dietary protein must be consumed to increase muscle protein synthesis [8]. Dancers have been found to consume an average of 1.6 ± 0.5 g/kg/day [13], similar to the average consumption of the current study (1.4 ± 0.5 g/kg/day). Even though the majority of dancers consume adequate protein when compared to the general population recommendation (0.8 g/kg/day), other athletes have shown maintenance of lean mass during reduction of fat mass when consuming up to 2.3 g/kg/day throughout a hypoenergetic diet [9]. Though not apparent in this study, possibly due to lab testing not being a direct measure of dance performance, the combination of reduced body weight and improved body composition may impact performance and dance aesthetics. The small differences in fat mass (kg) between HP and MP (-7.0%, $d = 0.236$) or LP (-12.0%, $d = 0.402$, respectively) may be physiologically important regardless of the lack of differences in performance measures reported in this study. Similarly, Antonio et al. [19] observed lower body fat (%) in a group of resistance trained men and women consuming high protein (3.4 g/kg/day; -0.1 ± 2.5 kg body mass,

-2.4 ± 2.9% fat mass) compared to those who participated in the same training but consumed less protein (2.0 g/kg/day; +1.3 ± 1.3 kg body mass, -0.7 ± 2.8% fat mass). Interestingly, the two groups were not isocaloric and the high protein group consumed significantly greater total calories (2,614 ± 80 kcal) when compared to those who consumed less protein (2,119 ± 74 kcal) at post testing.

Increased protein consumption has been documented to positively impact body composition and performance [9, 20-22]. Aesthetic athletes in particular may benefit from increased protein consumption in order to maintain a lean physique (low body fat) while optimizing performance (attenuate lean mass loss). In the present study, those in HP had lower body weight (kg) of which a greater percentage was lean mass when compared to those in LP. Similarly, in athletes where weight loss is favored while preserving muscle, higher protein intake (25.0%-35.0% total calories) has an advantage due to the greater thermic effect of food, satiety response, and sparing effect of lean mass [23]. However, specific recommendations for dancers must account for current body composition and training style as this study did not account for the primary style of dance training (ballet or modern).

Young (21 ± 2 years of age) female professional dancers have previously been found to have a mean of 19.4 ± 4.3% body fat (DXA) [24]. However, data observing adolescent (11 ± 2 years of age) ballet dancers alone have found body fat to be as low as 17.4 ± 4.7% [4] although this likely a function of having not yet gone through puberty. Average body fat in the current study (26.2 ± 4.5 %) was substantially higher than previous findings (19.4 ± 4.3%) among professional dancers [24]. This difference could be attributed to the recruitment of collegiate dancers training in ballet and modern dance as opposed to professional ballet dancers. Additionally, lean body mass (70.1 ± 4.5%) was found to be lower in the current study compared to both adolescent (82.6 ± 4.7% lean mass) and professional (81.0 ± 3.3%) dancers [4, 24]. Comparing the findings of the current study to previously researched dancers has revealed an opportunity among collegiate dancers to optimize body composition through increasing lean muscle mass. However, it is critical to acknowledge that attempts to become more lean can have potential psychological effects as collegiate dancers are greater risk for unhealthy eating behaviors compared to professionals and non-dancers [25]. It is important to emphasize that the dancers in this study were of a healthy weight and in order to optimize body composition the focus should be primarily on improvements in lean muscle mass.

Dance involves different elements of fitness including cardiorespiratory fitness and muscular strength [26]. Dance science researchers are interested in dance fitness and performance parameters to better understand dance training and ways to optimize performance [26-29]. However, the relationship between diet and dance performance has not been investigated. The current study found no differences in performance between protein tertiles except for peak horizontal force during a grande jeté (F_y; $P = 0.029$). This difference indicates greater forward trajectory during the grand jeté in HP (419.9 ± 76.7 N) compared to LP (295.7 ± 111.1 N). Greater horizontal trajectory in a grand jeté could be either a performance benefit or hindrance depending upon style (i.e. ballet or modern) or preference of the choreographer. Therefore, it cannot be concluded that greater horizontal force during a grand jeté results in superior performance. The lack of differences in all other measurements may be partly due to the inadequate protein intake spread between groups. Data have previously shown performance measurements to be improved following a three-month supplemental aerobic and strength training program, however, diet was not monitored [26]. Research is warranted to investigate the effects of both a training program and protein intake on performance characteristics in dance.

A few limitations must be addressed. Menstrual cycle phase was not controlled for, however, this is unlikely to influence our outcome measures [10, 20]. Additionally, we recruited collegiate dancers from different dance backgrounds. Ballet places greater emphasis on body image than modern dance and may impact dietary behaviors in ballet dancers more so than modern dancers. Energy availability was not measured in this study, which may be reflected in greater energy intake in HP compared to LP. Therefore, the non-significant differences discussed in body composition may be influenced by energy expenditure and differences in dance training. Further research is needed to address the potential differences in dietary behaviors between dance styles to allow dietary recommendations to be matched to body composition and performance needs for dance training in different styles. Likewise, intervention studies are needed to observe the influence of protein intake on body composition and performance in dance athletes.

5. Conclusion

Tertiles of protein intake in the female collegiate dancers participating in this study were not significantly associated with more desirable body composition and performance. However, minor differences in body composition may be physiologically important for dancers in order to optimize the dancers' power-to-weight ratio. Further research should implement dietary interventions to determine the potential impact higher protein intake may have on dancers' body composition and performance.

Acknowledgments

The authors' responsibilities were as follows: original study design by AFB, TW, and MJO; data collection and analysis by AFB, CWB, GD and SWL; data interpretation and manuscript writing by AFB, CWB and MJO; study oversight by AFB and MJO; data interpretation and critical revision of the manuscript by AFB, CWB, TW and MJO. MJO is on the scientific advisory board for Dymatize Nutrition, a sports nutrition company that manufactures and sells protein products.

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