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The Impact of Nutritional Counseling in Conjunction with Co-active Coaching on Behavior Change of Varsity Female Rowers

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Abstract

Study background: The purpose of this study was to measure the impact of sport nutrition counseling in conjunction with co-active life coaching on sport nutrition knowledge and resulting dietary behavior change among a group of female varsity rowers.

Methods: Seven female athletes took part in a three-month study consisting of eight individual sport nutrition counseling sessions and eight co-active life coaching sessions. Athletes' sport nutrition knowledge was assessed using a Sport Nutrition Knowledge Questionnaire, and dietary behavior change was assessed through a subjective questionnaire, anthropometric measurements, and prospective completion of three-day food records.

Results: There was a significant change in participants' sport nutrition knowledge over the study period. Although not statistically significant, a change in athletes' fat mass and waist circumference were measured, and participants reported positively on the impacts of the study intervention. Alternatively, at the conclusion of the project, participants showed low energy availability and inadequate dietary intakes of both macro and micronutrients, both below the recommended requirements for sport.

Discussion: Despite eight weeks of sport nutrition counseling and co-active life coaching, participants still practiced eating behaviors that were potentially harmful to their health and performance. The study's findings suggest that the current intervention had a positive effect on the participants' sport nutrition knowledge but did not result in positive dietary behavior change.

Conclusions: Due to the limitations of the current study further studies are warranted in order to evaluate whether there is a causal link between sport nutrition counseling in conjunction with co-active life coaching and athletes' behavior change. Efforts toward authorization of validated practical interventions to decrease inadequate sport nutrition knowledge and diet behavior among athletes should be practiced.

Keywords: Nutrition counseling; Sport nutrition; Co-active life coaching; Behavior change; Female rowers

Introduction

Rowing activates all the major muscle groups of the human body [1]. Training intensities and volumes practiced in this sport at a competitive level are immense [2]. In order for a body to thrive from this type of training, incorporating sport nutrition knowledge into resultant behavior practices is necessary. Nutrition affects almost every process in the body that is involved in energy production and recovery from activity. Consuming a nutritionally adequate and balanced diet plays an important role in achieving and maintaining health, and reducing fatigue while allowing athletes to perform with more intensity and endurance, and recover more efficiently between training sessions [3]. To understand and apply the principles of sport nutrition, a basic understanding of nutrition is necessary [4].

Current research findings indicate that greater efforts should be focused on increasing sport nutrition knowledge and improving eating habits among female college-level athletes [5]. Although data specific to female collegiate heavyweight rowers is limited, some research evaluated the adequacy of dietary intake in 16 female heavyweight rowers. This study reported that the majority of the female rowers consumed below optimal levels of carbohydrates (<5 g/kg), had a much higher than recommended intake of fat (>35% of intake), and a significant proportion of the group were taking in less than two-thirds of the recommended dietary intake of calcium , zinc, and vitamins B6 and B12 [6].

Areas of nutrition that have been identified as invaluable to athletes include, energy consumption, nutrient intake, and hydration status [3,5]. Although proper training and optimal energy availability are essential to maximize both health and performance, access to nutrition resources may be limited for athletes [4].

Although it is assumed that people must have basic knowledge of nutrition to guide healthy food choice(s), more recent research has shown that nutritional education programs which focus purely on knowledge dissemination, without the addition of behavior change strategies and practical skills, may be less effective in eliciting positive lasting dietary change [7].

With a focus on determining what changes should be made and how to make the changes, literature suggests that combining the fields of sport nutrition counseling (NC) and behavioral psychology could achieve successful dietary behavior change [7]. This would allow nutrition information to be provided through counseling, with

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additional knowledge and skill(s) provided through behavioral change coaching [8]. The purpose of this study was to perform a pilot study that combined the fields of nutritional counseling with behavioral psychology in order to measure sport nutrition knowledge and resulting dietary behavior change among a group of female varsity rowers.

Materials and Methods

Participants

Participants were recruited through email by a member of the research support staff who did not have any relationship or hold any authority over the potential participants. Recruitment targeted female athletes on the fall 2015 varsity rowing team who had little or no previous or current nutrition coaching/ counseling. Athletes were excluded from participating if they had taken more than one university nutrition course or were currently working with a dietitian or nutrition professional. This criterion limiting prior knowledge about nutrition was designed to decrease the variability in nutrition knowledge and professional exposure of the participants. Heterogeneous variables were eliminated by removing gender as one of the biases and therefore this study only looked at female varsity athletes. Informed consent was obtained from seven Caucasian female participants; 19 years and older. The majority of participants competed within a heavy weight category, and one participant competed within a lightweight category. There was no control group included within this project. The participating athletes were in season for their varsity sport for the majority of the project period, with the last two weeks of the project in off-season.

Design and data collection

The total study period consisted of twelve weeks, including eight nutrition-counseling sessions, eight co-active life coaching (CALC) sessions, three BOD POD and waist circumference (WC) measurements, two rounds of questionnaire completion and completion of two three-day food records.

Questionnaires

Questionnaires were administered to participants at the beginning of the project period, and at the conclusion of the project. The questionnaires included an adapted Sport Nutrition Knowledge Questionnaire [9], administered at the beginning and conclusion of the project, as well as a subjective questionnaire administered at the conclusion of the project. The subjective questionnaire was administered to obtain each participant's thoughts about the effectiveness of the study interventions.

The Sports Nutrition Knowledge Questionnaire consisted of 79 questions. To assess adequate nutrition knowledge, questions were categorized into four domains of sports nutrition: nutrients, fluid, recovery, weight gain and weight loss. The nutrients portion focused on knowledge of particular foods that are high or low in carbohydrates, fats, and proteins, as well as micronutrients calcium and iron (score out of 42). The fluids section focused on knowledge of optimal hydration practices and sports drinks (score out of 11). Recovery items focused on macronutrient replacement, and timing (score out of 11). The focus of the weight gain questions was on practices to increase lean body mass (score out of 4) while weight loss focused on food choices (score out of 11). The Sport Nutrition Knowledge Questionnaire was chosen based on its validity and reliability for determining sports nutrition knowledge [9].

The subjective questionnaire consisted of 11 open-ended questions about their experiences during the project. In order to obtain a subjective description of what participants felt they had gained from the intervention, questions included three specific to CALC, three specific to sport NC, two specific to the combination of CALC and sport NC, and three additional general questions about their experience with the entire intervention and it's perceived benefits.

Three-day food record

To assess dietary intake of participants, a three-day food record was used that included two week days and one weekend day. Each athlete was provided with detailed written instruction regarding how to complete a three-day food record, and was asked to submit the record at the beginning and end of the 12-week study period. The three-day food record involved each athlete documenting their dietary intake as it occurred; providing a daily record of all foods and fluids consumed, quantity of food, how it was prepared and timing of meals and snacks. In addition, rowers also recorded their daily exercise involvement; including type, duration and intensity. The food record, as with other self-report methods, presents many challenges [10]. The three-day food record, however, was chosen as it has been used as an effective tool to collect information on athletes' dietary intake [11,12], and is reported to be an effective and commonly used tool among health professionals for assessing dietary intake and quantities [13]. One athlete was excluded from all of December's dietary measurements due to sickness during the time of the three-day food recordings. This exclusion resulted in seven participants involved in the September analysis and six in the December analysis.

Esha food processor software

Diet records were analyzed for energy and nutrient intake using ESHA Food Processor diet analysis software (version 10.14, ESHA Research, Salem, OR). This software uses a research quality nutrient database that includes data from the Canadian Nutrient Files. The ESHA Food Processor provided a preliminary assessment, which helped to determine the rowers' nutritional adequacies, inadequacies and their needs relative to their sport requirements and physical performance. Follow up contact was performed with participants to clarify specific items and/or obtain more detail on their food records when necessary.

Nutrition counseling (NC)

The ESHA Food Processor information was then reviewed with each participating athlete during individualized NC sessions, discussing whether or not the participants' food record had met their recommended micro and macronutrient requirements.

The project included thirty-five minute individual counseling sessions every week for eight weeks. Participants were provided resources pertaining to any inadequate macro and micronutrients that were shown upon analysis of their three-day food record. The resources provided to the athletes all came from available client handouts on Practice-Based Evidence in Nutrition (PEN) [14]. A couple of example titles of the handouts provided to athletes include, "Food Sources of Calcium", "Food Sources of Vitamin D" and any other micronutrients that the athletes diets were inadequate in. The content provided within these handouts included, information on the specific nutrient (e.g. calcium), the recommended amounts they should be consuming, as well as the content of the particular nutrient found in common foods. All other sport nutrition information provided to the athletes originated from current literature and faculty mentors' expertise in the area of sport nutrition.

Co-active life coaching (CALC)

CALC was used in addition to NC. All four CALC coaches who participated in the study were accredited with the Coaches Training Institute (CTI) [15]. These life coaches were randomly recruited from a list of CTI-accredited coaches who were interested in doing pro-bono coaching for the sake of advancing research on life coaching. All participants received coaching according to the model and tenets of co-active coaching, and therefore any variation was not in the coaching but in how each participant responded to the coaching and any resulting change(s) they chose to make. These coaches (n=4) were assigned to work individually with one or two athletes for thirty-five minutes each week for eight weeks. The number and length of both the NC and life coaching sessions was standardized in order to maximize the project's internal validity and rigor. The coaches' role within the intervention was to work as a team with their assigned participants, to clarify their goals and develop strategies to achieve them.

BOD POD and waist circumference (WC)

Air Displacement Plethysmography (ADP) is a body composition instrument that uses a two compartment (2-C) model. It is a validated method available for body composition assessment in athletes [16]. The 2-C model quantifies the body into two components: fat and fat free mass (FFM) [17]. BOD POD (Life Measurement Instruments, Concord, Calif) and WC assessments were used throughout the project as methods for measurement of the participants' body composition and physical dimensions. Measurements were taken every four weeks on a consistent day of the week and time of day to increase reliability of measurements. Participants were asked to wear tight clothing for the test (spandex exercise clothing; compression shorts and a sports bra, or a Speedo-type swim suit) and to abstain from eating a large meal or from exercise for three to four hours before BOD POD testing for optimized accuracy of measurements [18]. WC is a reliable anthropometric screening tool used as an indirect indicator of fat mass and distribution in the abdominal area [19]. WC of each participant was measured three times to the nearest 0.1 cm, with an average of the three measurements used for the final analysis.

Data analysis

The project's success was measured through data analysis of two completed Sport Nutrition Knowledge Questionnaires, two completed three-day food records, three completed BOD POD and WC measurements, and one subjective questionnaire.

Sport nutrition knowledge questionnaire: Questionnaire scores were calculated by assigning +1 for each correct response, and 0 for unsure or incorrect responses. Each athlete received a score out of 79 in both September (to represent a baseline measurement of knowledge) and December (to represent knowledge at the end of the study). The changes in scores from September to December were then analyzed to determine if there were any increases in the sport nutrition knowledge of athletes over the study period.

Three-day food records

The three-day food records were analyzed by comparing each athlete's averaged macronutrient and micronutrient intake value over the recorded three days to their recommended Dietary Reference Intake (DRI) values provided on ESHA®. DRIs represent the energy and nutrient standards for a general healthy population [20]. Currently there are no DRI's specific to an athletic population.

Energy intake (EI) was evaluated using energy availability (EA). EA is the amount of energy available to the body to perform all other functions after the cost of exercise is subtracted, and it sets an important foundation for health and the success of sports nutrition practice [3]. The concept of EA was initially studied in females where an EA of 45 kcal/kg FFM/d was associated with energy balance and optimal health. In contrast, a chronic reduction in EA (below 30 kcal/kg FFM/d) was associated with a variety of body function impairments [3]. In this study, EA was highlighted if it was <30 kcal.

Resting metabolic rate (RMR), which is the minimum number of calories needed to support an individual's basic body functions, was calculated by applying the Cunningham equation [17] with the athlete's measured body composition results (Equation 1).

$$RMR = 500 + 22\ (FFM\ in\ kg) \quad (1)$$

Energy expenditure (EE) was calculated by using each participant's determined RMR to estimate their average daily exercise energy expenditure (EEE; Equation 2; [17]).

The compendium of physical activities [17] was used to derive intensity of activities in Metabolic Equivalent of Task (METS).

$$EE = (METS\ (RMR \div 24\ hrs)) - (RMR \div 24\ hrs) \quad (2)$$

$$EA = (EI - EEE) \div FFM \quad (3)$$

The dietary fat component was highlighted if participants were having less than 20% or more than 35% of their total caloric intake in fat. Currently there are no weight-based guidelines for athletes in terms of dietary fat intake. Therefore, it is advised that athletes follow the Acceptable Macronutrient Distribution Range (AMDR) for dietary fat, ranging from 20-35% of their total EI [3,5]. Consuming below or equal to 20% of energy from fat does not benefit athletic performance, as fat is required for a source of energy, fat soluble vitamins and essential fatty acids in the diets of athletes [3]. Claims that high-fat, carbohydrate restricted diets provide a benefit to the performance of athletes are not supported in a recent position statement from the Dietitians of Canada, the Academy of Nutrition and Dietetics and the American College of Sports Medicine [3].

Protein (PRO) was highlighted if participants had less than 1.2 g/kg/d. This level is considered to be the minimum amount of PRO required for adequate recovery and tissue repair for all athletes [5]. Expressing PRO requirements in grams per kilogram of body mass, rather than in AMDR as a proportion of total EI, reflects athletes' needs more accurately. Current data suggests that athletes should consume dietary PRO from 1.2 to 2.0 g/kg/day [3].

Carbohydrates (CHO) were highlighted if participants had less than 5 g of CHO/kg/d. Studies have reported that a minimum of 5 g/kg of dietary CHO is needed in order to maintain adequate glycogen stores to support an athlete's training on a regular basis [5]. Endurance athletes are advised to consume 6-10 g/kg/d [3].

Fluid was highlighted if participants were having less than the 2.2 L (9 cups)/d. Women of 19 years old and over are recommended to consume 2.2 L each day [20,21].

Fiber was highlighted if it was under 100% of recommended amounts (DRI=25 g/d of Fiber for women 19-50 years) [20].

Individual vitamins and minerals were highlighted if they were under 100% of the recommended DRI, [14,20] as athletes should be consuming diets that provide at least the DRI for all micronutrients [3].

Sodium was highlighted if it was above the Tolerable Upper Intake Level (UL) (2300 mg) [20].

Additional analysis was applied to the three-day food records by manually recording athletes' servings of each food group and averaging the number of fruits, vegetables, grains, milk and meat servings over their three day consumption compared to an adapted Canada's Food Guide for adult females aged 19-50 years, based on a 2,000 kcal diet [17].

BOD POD + WC measurements

BOD POD data was analyzed by using participants' measured FFM to obtain estimated EA for each athlete as well as comparing all three BOD POD results for each participant and recording whether they had gained or lost mass, gained or lost lean mass, and gained or lost fat mass over the study period. WC measurements were analyzed by calculating whether participants had a decrease in WC from baseline to the conclusion of the study.

Subjective questionnaire

A thematic analysis was applied to the subjective questionnaires by reviewing participants' answers to the eleven questions and identifying any patterns of recurring words or answers to questions.

Statistical analysis

The proportion of athletes above versus below a specific threshold for each nutrient/dietary component was assessed using Chi-squared analyses (Excel 2011, Microsoft Corp, Seattle, WA, USA). Statistical significance was set at the 0.05 level.

Results

Sport nutrition knowledge questionnaires

The mean of the questionnaire scores was 50 (out of 79) in September (Table 1). This mean was used as base to assess December's results. In December, the proportion of athletes above the mean was significantly greater than in September (p=0.02).

Three-day food records

The proportion of athletes above versus below the minimum recommended amount of EA, PRO, CHO, and fluid was not significantly different between September and December (p=0.8, 0.8, 0.2. 1.0 respectively). The proportion of athletes above versus within the recommended range of fat consumption, and above versus below the recommended amount of fiber was not significantly different between September and December (p=0.3, 0.2 respectively). Refer to (Table 2).

The proportion of athletes with inadequate dietary intake of vitamins was not significantly different between September and December for vitamin A (p=0.8), vitamin B12 (p=0.4) and folate (p=0.3). In contrast, the proportion of athletes with inadequate dietary intake of vitamin B1/ thiamin was significantly greater in December compared to September (p=0.03). It was not possible to evaluate the statistical significance for participants' dietary intake of vitamin D as all athletes consumed <100% of the DRI in both September and December. The proportion of athletes with inadequate dietary intake of minerals was not significantly different between September and December for calcium (p=0.2), magnesium (p=0.3), and iron (p=0.8). It was not possible to evaluate the statistical significance for participants' dietary intake of potassium as all athletes consumed <100% of the DRI in both September and December. The proportion of athletes that were consuming over the UL of sodium was not significantly different between September and December (p=0.8). Refer to (Table 3).

The proportion of athletes not meeting the recommended number of food group servings was not significantly different between September and December for vegetables (p=0.9), grains (p=0.4), milk and alternatives (p=0.4), and meat and alternatives (p=0.3). It was not possible to evaluate the statistical significance for participants' fruit intake as all athletes consumed <100% of the recommended servings/d in both September and December. Refer to (Table 4).

BOD POD + WC measurements

BOD POD anthropometric measures showed that out of the seven participants four athletes lost body mass, two athletes gained body mass, and one athlete maintained body mass.

Out of the four participants that lost body mass, one athlete lost lean body mass as well as fat mass, while the other three participants gained lean mass, lost fat mass and lost body mass. The four participants that showed a decrease in body mass over the course of the study period also showed a decrease in waist circumference.

The body mass that the participating athletes gained was due to a gain in both lean and fat mass. These two participants showed an increase in waist circumference over the course of the study period.

The athlete that maintained her body weight was a result of an equal gain in lean mass and loss in fat mass. It was not possible to evaluate the statistical significance for participants' anthropometric measurement results. Refer to (Tables 5 and 6).

Participant	September	December
A012	50	55
A013	49	50
A015	47	54
A014	53	63
A018	59	54
A011	45	52
A016	48	55

Table 1: Sport nutrition knowledge questionnaire scores at baseline (September) and end of study (December).

	EA (kcal/FFM/d)		Fat Intake (%)		PRO Intake (g/kg/d)		CHO Intake (g/kg/d)		Fluid Intake (L/d)		Fiber Intake (g/d)	
Participant	September	December	September	December	September	December	September	December	September	December	September	December
A012	30.33	---------	35.87	---------	1.04	---------	3.40	---------	1.9	---------	29.90	-
A013	30.10	31.27	26.50	29.70	1.01	1.04	5.11	3.76	-----------	---------	37.00	35.18
A015	35.23	32.78	29.46	33.41	2.13	2.10	4.16	3.01	-----------	2.4	32.43	22.86
A014	28.98	19.67	36.00	29.75	1.17	1.08	3.41	2.89	2.2	2.4	27.67	24.65
A018	23.82	15.82	25.30	20.23	1.36	1.43	3.89	3.98	2.1	2.0	31.74	33.35
A011	27.52	17.08	67.23	40.37	1.30	0.74	1.20	2.18	4.0	1.8	20.67	15.61
A016	32.06	32.72	26.30	27.85	1.49	1.55	5.11	4.27	2.8	2.2	23.61	24.84

Table 2: Energy, macronutrient, fluid and fiber analysis results.

List of Vitamins and Minerals with their DRIs for Specified Gender and Age and Sodium with the UL for Age	September (/ 7 athletes)	December (/6 athletes)
Vitamin D (600 IU/d) (F 14-70y)	7	6
Vitamin A (700ug/d) (F 14y +)	3	3
Vitamin B12 (2.40 mcg/d) (F 14y +)	1	2
Folate (400mcg/d) (F 14y +)	4	5
Vitamin B1 (Thiamin) (1.1 mg/d) (F 19y +)	0	3
Calcium (1000.0mg/d) (F 19- 50 y)	5	2
Magnesium (310.0mg/d) (F 19- 30 y)	3	1
Potassium (4700.00mg/d) (F 14y +)	7	6
Iron (18mg/d) (F 19-50 y)	4	3
Sodium (2300mg/d) (14-71 y)	4	3

Table 3: Dietary vitamin and mineral intake < 100% of DRI and sodium intake > UL (2300 mg).

	Fruit (4 recommended)		Vegetable (5 recommended)		Grain (6-7 recommended)		Milk and Alternatives (2 recommended)		Meat and Alternative (2 recommended)	
Participant	September	December	September	December	September	December	September	December	September	December
A012	1.7	-----------	4.4	-----------	5.0	-----------	1.8	-----------	2.0	-----------
A013	1.7	2.2	6.6	3.3	10.0	3.1	0.7	1.0	2.3	2.7
A015	2.7	2.7	3.4	4.1	6.0	4.2	4.1	3.0	5.3	5.2
A014	3.9	2.0	3.7	7.3	2.7	2.1	1.4	2.8	5.1	2.7
A018	1.7	1.8	4.4	4.5	7.2	7.0	1.0	1.4	3.9	2.4
A011	2.6	2.0	4.8	1.2	0.0	3.5	2.2	1.6	3.7	1.8
A016	1.0	2.0	1.3	4.7	7.6	8.1	1.7	2.1	3.0	3.3

Table 4: Food group average number of servings/d.

	Body Mass (kg)		Lean Mass (kg)		Fat Mass (kg)		Body Fat (%)		WC (cm)	
Participant	September	December	September	December	September	December	September	December	September	December
A012	77.0	79.7	53.6	55.4	23.4	24.3	30.4	30.5	87.8	91.3
A013	70.8	71.6	54.6	54.7	16.2	17.0	22.9	23.7	80.0	81.2
A015	78.3	74.5	58.8	57.0	19.5	17.5	24.9	23.5	84.7	83.0
A014	92.0	91.4	65.4	67.4	26.6	24.0	28.9	26.2	92.7	90.3
A018	61.5	61.1	48.3	48.6	13.2	12.6	21.5	20.6	75.0	73.5
A011	72.7	72.7	52.6	54.5	20.1	18.1	27.6	24.9	84.3	79.8
A016	70.0	69.0	60.4	61.2	9.6	7.8	13.7	11.3	82.0	76.8

Table 5: Anthropometric measurements.

	# of Athletes that Lost Body Mass	# of Athletes that Gained Body Mass	# of Athletes that Maintained Body Mass
Number of Participants	**4 athletes**	**2 athletes**	**1 athlete**
Lost Lean mass	1/4	0	0
Gained Lean mass	3/4	2/2	1/1
Lost fat mass	4/4	0/2	1/1
Gained fat mass	0/4	2/2	0/1
Waist circumference decrease	4/4	0/2	1/1
Waist circumference increase	0/4	2/2	0/1

Table 6: End of study anthropometric measurement results (BODPOD and WC).

Subjective questionnaire

All athletes reported that their CALC sessions focused on one or more of the following: an increase in positive outlook, awareness and reflection of themselves, their behaviors and values.

Five out of the seven athletes reported that they had noticed one or more behavior or perspective changes in their life over the course of their eight CALC sessions. Each athlete mentioned one or more of the following: increased awareness of self and values, positive outlook and being more positive in general.

Five out of the seven athletes reported that they planned to continue practicing their behavior or perspective changes that they had adopted over the eight CALC sessions.

Two out of the seven participants reported that they did not notice any behavior or perspective change in their life as a result of the CALC sessions and did not find the CALC sessions to be useful.

Nutrition counseling (NC) subjective analysis

All seven athletes reported that the NC sessions focused on one or more of the following: an increase in awareness of what they were eating, what they should be eating, knowledge of what a proper diet should look like, and tools to incorporate required amounts of all food groups in a diet. All seven athletes reported that they learned something from the eight NC sessions they attended, and that they were committed to the changes they had made in their diet based on the knowledge they had gained, with respect to a balanced and adequate diet over the course of their eight nutritional counseling sessions.

Subjective view of both CALC and NC in conjunction

Five out of the seven athletes expressed that sport nutrition education in conjunction with CALC had a positive impact on them as an athlete. These five athletes reported that the positive outlook, self-awareness and reflection gained in CALC made it easier to apply the nutrition knowledge they had learned.

Two out of the seven athletes expressed that only the sport nutrition education had a positive impact on them as athletes in terms of maintaining weight and becoming aware of what was going into their body.

Five out of seven athletes expressed a belief that athletes would benefit from having access to CALC, NC and anthropometric measures, as it provided them with mental benefits, sport nutrition knowledge and periodic physical assessment of their body mass. Participants believed these things to be of value to an athlete. Two out of seven athletes expressed a belief that athletes would benefit from having access to only the NC and anthropometric measures for the same reasons mentioned by the other participants. All seven athletes expressed beliefs that future female rowers could benefit from the effective strategies and resources that they gained from this project.

Discussion

Sport nutrition knowledge

The analysis of the sport nutrition knowledge questionnaire data suggests that there was a significant change in athletes' sport nutrition knowledge over the study period. Although the questionnaire findings indicated that athletes' sport nutrition knowledge had increased, some of their behaviors did not consistently reflect this finding.

Three-day food records

Four of the athletes' baseline energy intake met the lower EA recommendations of 30-45 kcal/kg FFM/d (averaging 32 kcal/kg FFM/d). This intake is reported to be a reduced EA but still adequate for healthy weight loss [22]. The remaining three participants' intake (averaging 27 kcal/kg FFM/d) were below the suggested lower threshold of EA for female athletes at 30 kcal/kg FFM/d [3,22]. These findings are consistent with a recent article's findings that 41 out of 45 female college athletes' intakes of energy were below the minimum recommendations [5].

At the conclusion of the study, the same athletes met the lower EA recommendations and the same three athletes were below the suggested lower threshold. The three athletes that did not meet the threshold at the beginning of the study had a lower EA in December (averaging 17.5 kcal/kg FFM/d). These numbers are concerning when low EA is recently recognized as an independent factor of poor bone health at all levels of energy deficiency due to decreased IgF-1 (insulin like growth factor gene 1) and bone formation marker levels [23].

The proportion of athletes above versus below the minimum recommended amount was not significantly different between September and December, therefore suggesting that the study interventions of the sport nutrition knowledge dissemination and CALC did not have an impact on the participants' caloric intake. Athletes' dietary choices should promote adequate EA for energy balance and weight maintenance (45 kcal/kg FFM/d) [3,22] or healthy weight loss (30-45 kcal/kg FFM/d) [22]. It should be acknowledged that low EA is not equivalent to negative energy balance or weight loss. If a decline in EA is associated with a decline in RMR, the body may produce a new weight stability at a lowered energy intake that is insufficient to provide for healthy body function [3].

Inconsistent with literature findings [6], baseline food records showed that more than half of the athletes within the current study sample (four athletes) had fat consumptions consistent with the recommended range (20-35% of total energy intake) [3], while three of the athletes reported consuming above the recommended range. At the conclusion of the study five of the participants were within the recommended fat ranges, while only one athlete had consumption above the recommended range. This decreased intake of fat is consistent with findings from a recent systematic review completed on nutrition knowledge and dietary intake [7]. However, the proportion of athletes above versus within the recommended range was not significantly different between September and December, therefore suggesting that the study interventions did not have an impact on the participants' fat consumption.

Inconsistent with literature findings [6], both in September and December, three athletes had a protein intake below the target recommendations for both strength and endurance athletes (1.2-1.6 g/kg/d) [22]. Although these findings would theoretically result in a loss of lean mass due to insufficient intake of PRO, none of the athletes demonstrated this result in their final BOD POD values compared to their lean mass values at the onset of the intervention. The proportion of athletes above versus below the minimum recommendation for protein was not significantly different between September and December, therefore suggesting that the study interventions did not have an impact on the participants' PRO consumption.

Athletes are advised to consume carbohydrate amounts of 6-10 g/kg/d to maintain immune function, and recover glycogen stores [3,22]. Consistent with literature findings [5,6], the majority of participants in September and all participants in December consumed <5 g of CHO/kg/d. The proportion of athletes above versus below the minimum recommended amount for CHO was not significantly different between September and December, therefore suggesting that the study interventions did not have an impact on the athletes' CHO consumption. Regardless of the intervention findings within this study, the athletes' CHO consumption raises potential concern, as training with limited carbohydrate availability has been reported to impair training intensity and duration [3]. Adequate energy intake, particularly from carbohydrates, is important to match an athlete's energy expenditure, in order for amino acids to be spared for protein synthesis and not oxidized [3].

Three athletes did not have complete records of their fluid intake. Of the Athletes who recorded their fluid intake both in September and December, three athletes met the 2.2 L/d recommendation for women of 19 years old and over [20,21], while the remaining two did not. The proportion of athletes above versus below the minimum recommended amount was not significantly different between September and December, therefore suggesting that the study interventions did not have an impact on the athletes' fluid consumption. Proper fluid consumption is important as dehydration and hypo hydration can increase the perception of effort and impair exercise performance. In addition to the generalized fluid recommendations for women of 19 years old and over, athletes are advised to replace their sweat losses [3].

Inconsistent with literature findings [7], athletes' fiber intake did not improve over the intervention period, but instead regressed by an additional two athletes; resulting in four athletes consuming below the recommended 25 g/d of fiber. Although there was a reduction in fiber intake, the proportion of athletes above versus below the recommended amount was not significantly different between September and December. This suggests that the study interventions did not have an impact on the participants' fiber intake.

There were no improvements among intake of the common vitamins (more than one participant <100% DRI) at the conclusion of the study, and the number of athletes that had <100% of the DRI at the onset of the study were in equal numbers or more at the conclusion of the study. Vitamin B1 (thiamin), in particular, rose from zero athletes to three athletes <100% DRI at the conclusion of the study; a significant change. Findings similar to these have not been found in the literature. The findings regarding B12 are consistent with literature findings reporting low B12 in the diet of female rowers [6], but all other vitamins that were found to be low in more than one participant within this intervention are inconsistent with the literature findings. The projects' findings suggest that the study interventions did not have an impact on the participants' dietary choices that promoted an increased intake of food sources of the common vitamins mentioned. It should be acknowledged, however, that vitamin D is not found naturally in many commonly consumed foods and dietary interventions alone have not been shown to be a dependable means to resolve insufficient status [3].

The suboptimal findings of the common minerals within this group of female rowers are consistent with research findings [6]. The number of athletes that were found to be <100% of the DRI at the onset of the study, excluding potassium, decreased in number at the conclusion of the study. However, the proportion of athletes with inadequate dietary intake was not significantly different between September and December, therefore suggesting that the study interventions did not have an impact on the participants' dietary choices that promoted an increased intake of food sources rich in the common minerals mentioned.

The proportion of athletes that were consuming over the UL of sodium was not significantly different between September and December. This suggests that the study interventions did not have an impact on the participants' dietary choices that promoted a decreased intake of sodium.

The proportion of athletes not meeting recommended servings of each food group was not significantly different between September and December. This suggests that the study interventions did not have an impact on participants' dietary choices that promoted optimal intake of the five food groups. Although not statistically significant, the improvement of milk and alternative consumption could be a notable food group change, with its positive effects on participants' dietary calcium values.

BOD POD + WC measurements

Out of the seven study participants, four lost body mass as well as showed a reduction in WC. One athlete lost fat mass but gained the same amount of lean mass, and showed a decrease in WC. These results are consistent with research findings that a decrease in WC can be attributed to changes in diet, as well as CALC interventions [24].

The decreased body mass in four of the athletes and decreased waist circumference in five, suggests that the sport nutrition knowledge dissemination and CALC had an impact on participants' dietary behavior change. Although this finding of decreased body mass and waist circumference is positive, it is not consistent with some of the athletes' reported energy and macronutrient consumptions, indicating some of the study limitations.

Subjective questionnaire

The feedback received from the majority of the participants suggests that the intervention of sport nutrition knowledge dissemination and CALC had a positive impact on participants' nutrition knowledge and behaviors. The majority of the athletes believed that the exposure of the two areas together made application of knowledge into behavior change easier, while two athletes believed they just benefited from the knowledge dissemination portion of the study. All athletes who took part in this intervention expressed they had gained effective strategies and/or resources, and believe that future rowers could benefit from the services that were provided to them during the study period.

Limitations

There are several limitations within this study that should be noted. Firstly, although participants were well trained with respect to how to keep food records, and a nutrition student reviewed all records, the lower daily energy, protein and carbohydrate and all the common micronutrient intake findings may have been a result of athletes' under reporting within their food records [3,25]. Additionally, the accuracy of participants' food intake may have been improved upon if all athletes were supplied with scales to weigh foods consumed [10]. However, analysis of the available data on misreporting when using estimated (used within this study) *vs.* weighed food record methods has reported no significant difference between the two [26]. Secondly, it is possible that the female athletes who volunteered to participate for this study had a greater interest, compared to other athletes, in sport nutrition and behavior change, or perhaps were experiencing issues that encouraged them to participate in the study. Consequently, the findings of these participants may not represent dietary intakes and eating habits of other female varsity rowers. For these reasons as well as the significantly small sample size within this study, the findings cannot be generalized to all female varsity rowers. Thirdly, although dual energy x-ray absorptiometry (DXA) has the lowest reported standard error for body composition assessments, because of accessibility and cost, an alternative method was used within this study. Air displacement plethysmography, performed by the BOD POD, may have underestimated the body fat of the study participants by 2-3% [3,27]. Fourth, a control group was not used within this study, which reduced the ability to determine whether the treatment was associated with the observed changes. For example, although the WC results are consistent with research findings that state a decrease in WC can be attributed to changes in diet, as well as CALC interventions, this cannot be confirmed from this study. Although a number of participants showed a decrease in WC at the conclusion of the study, this could have been due to increased training demands, academic stress or other reasons. Future long-term studies must be completed to follow athletes through different training periods, with a larger sample size, and a control group of athletes. This will help to identify whether there is a causal link between nutrition knowledge with CALC interventions and a decrease in WC.

Conclusion

The purpose of this project was to measure whether Co-Active Life Coaching (CALC) in conjunction with Nutritional Counseling (NC) would have an impact on the sport nutrition knowledge and dietary behavior of a group of seven female varsity rowers.

The hypothesis of sport nutrition counseling in conjunction with CALC having a positive impact on the group of athletes was supported with some of the study's findings, but the majority of differences were not statistically significant. One measurement that supported the hypothesis was the significant change in participants' sport nutrition knowledge over the study intervention period. Other measures that supported the hypothesis but were not statistically significant included a change in dietary Calcium values with a change in vegetable and milk and alternative consumption, a change in fat mass and WC, subjective feedback that the intervention had a positive impact on participants nutrition knowledge and behaviors, and the perception that future rowers could benefit from such an intervention.

Baseline measures showed that participants had low energy availability (EA) and inadequate dietary intakes of both macro and micronutrients that were below the recommended requirements for sport. Despite eight weeks of sport NC and CALC, participants still practiced eating behaviors that were potentially harmful to their health and performance. The study's findings suggest that the current intervention had a positive effect on the participants' sport nutrition knowledge but did not always result in positive dietary behavior change. Due to the limitations of the current study further studies are warranted in order to evaluate whether there is a causal link between NC in conjunction with CALC and athletes' behavior change. Efforts toward authorization of validated practical interventions that can improve knowledge and sport nutrition practices among athletes should be applied. In order for this to occur, future studies should be completed with control groups, over a longer term, with much larger samples, including both genders, and across a variety of sports. In the meantime, health professionals and coaches should acknowledge the importance of adequate dietary intake, eating behaviors and the impact both have reported to have on athletes' quality of training, recovery and overall health [3].

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References

1. Mazzone T (1988) Kinesiology of the rowing stroke. NSCA Journal 10: 4-11.
2. Nilsen T (2014) Basic rowing physiology. World Rowing
3. Thomas DT, Erdman KA, Burke LM (2016) Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and athletic performance. J Acad Nutr Diet 116: 1-528.
4. Torres-McGehee TM, Pritchett KL, Zippel D, Minton DM, Cellamare A, et al. (2012) Sports nutrition knowledge among collegiate athletes, coaches, athletic trainers, and strength and conditioning specialists. J Athl Train 47: 205-211.
5. Shriver LH, Betts NM, Wollenberg G (2013) Dietary intakes and eating habits of college athletes: are female college athletes following the current sports nutrition standards? J Am Coll Health 61: 10-16.
6. Steen SN, Mayer K, Brownell KD, Wadden TA (1995) Dietary intake of female collegiate heavyweight rowers. Int J Sport Nutr 5: 225-231.
7. Spronk I, Kullen C, Burdon C, O'Connor H (2014) Relationship between nutrition knowledge and dietary intake. Br J Nutr 111: 1713-1726.
8. Brownell KD, Cohen LR (1995) Adherence to dietary regimens. 2: Components of effective interventions. Behav Med 20: 155-164.
9. Zinn C, Schofield G, Wall C (2005) Development of a psychometrically valid and reliable sports nutrition knowledge questionnaire. J Sci Med Sport 8: 346-351.
10. Thompson FE, Subar AF, Loria CM, Reedy JL, Baranowski T (2010) Need for technological innovation in dietary assessment. J Am Diet Assoc 110: 48-51.
11. Erdman KA, Tunnicliffe J, Lun VM, Reimer RA (2013) Eating patterns and composition of meals and snacks in elite Canadian athletes. Int J Sport Nutr Exerc Metab 23: 210-219.
12. Lun V, Erdman KA, Reimer RA (2009) Evaluation of nutritional intake in Canadian high-performance athletes. Clin J Sport Med 19: 405-411.
13. http://www.pennutrition.com/KnowledgePathway.aspx?kpid=16177&trid=16445&trcatid=38
14. http://www.pennutrition.com/home.aspx
15. http://www.coactive.com/why-cti/what-is-co-active
16. Baracos V, Caserotti P, Earthman CP, Fields D, Gallagher D, et al. (2012) Advances in the science and application of body composition measurement. JPEN J Parenter Enteral Nutr 36: 96-107.
17. Doyle JA, Dunford M (2015) Nutrition for sport and exercise. (3rdedn) Stamford, USA: Cengage Learning.
18. Life Measurement Inc (2004) BODPOD operator's manual.
19. Pen Nutrition (2016) Healthy weight/obesity- assessment. Dietitians of Canada.
20. Otten JJ, Hellwig JP, Meyers LD (2006) Dietary DRI reference intakes: The essential guide to nutrient requirements. The National Academies Press, Washington, D.C.
21. Dietitians of Canada (2014) Guidelines for drinking fluids to stay hydrated.
22. Maughan R, Burke L, Coyle EF (2012) Nutrition for athletes: A practical guide to eating for health and performance. Nutrition working group of the International Olympic Committee.
23. Mountjoy M, Sundgot-Borgen J, Burke L, Carter S, Constantini N, et al. (2014) The IOC consensus statement: beyond the female athlete triad--relative energy deficiency in sport (RED-S). Br J Sports Med 48: 491-497.
24. Newnham-Kanas C, Irwin JD, Morrow D (2008) Co-active life coaching as a treatment for adults with obesity. Int J Evid Based Coach Mentor 6: 1-12.
25. Hill RJ, Davies PS (2002) Energy intake and energy expenditure in elite lightweight female rowers. Med Sci Sports Exerc 34: 1823-1829.
26. Poslusna K, Ruprich J, De Vries JH, Jakubikova M, Van't Veer P (2009) Misreporting of energy and micronutrient intake estimated by food records and 24 hour recalls, control and adjustment methods in practice. Br J Nutr 101: S73-85.
27. Ackland TR, Lohman TG, Sundgot-Borgen J, Maughan RJ, Meyer NL, et al. (2012) Current status of body composition assessment in sport. Sport Med 42: 227-249.

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