Dietary Intake of Female Collegiate Heavyweight Rowers

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The purpose of this study was to evaluate the adequacy of dietary intake in 16 female heavyweight rowers during the sprint racing phase of the season. Caloric intake for the rowers was 2,633 kcal/day, lower than expected given the training regimen of these athletes. On average, rowers consumed below-optimal levels of carbohydrate. Protein intake was satisfactory but fat intake was higher than recommended. For the majority of rowers, micronutrient intake met the RDA. However, calcium, zinc, B₆, and B₁₂ fell short of meeting two-thirds of the RDA for a significant percentage of rowers. The pre-event meal consumed both 15 hr and 2 hr before the event provided less carbohydrate and fluid but more fat than desirable. Female heavyweight rowers would benefit from nutritional counseling that provides strategies for increasing complex carbohydrates, calcium, zinc, B₆, and B₁₂ while reducing dietary fat. Adequate fluid intake is also essential.

Key Words: nutrition, athletes, carbohydrate

The sport of rowing is performed by two, four, or eight individuals using one oar each (sweep rowing) or by one, two, or four rowers using two oars each (sculling). During competition, the objective is to propel the boat or shell as fast as possible over a distance of 2,000 m. An all-out effort is exerted by women for approximately 6 min (8).

Success in international competition has been shown to be related to technical skills in rowing and a high level of fitness (5, 11). Maximal aerobic capacities of competitive rowers are among the highest recorded (6, 9). In women rowers, the relative energy contributions for 3 min of simulated rowing (measured on an ergometer) are 45% anaerobic and 55% aerobic (6).

Given the high energy demands of the sport, adequate calorie and nutrient intake is an important consideration. However, there is limited information avail-
able regarding the dietary intake patterns of female collegiate rowers. Therefore, the purpose of this study was to evaluate the adequacy of dietary intake in female heavyweight rowers during the sprint racing phase of the season (spring).

Methods

Subjects

Subjects were 16 female heavyweight collegiate rowers who had a mean (±SD) age of 21.0 ± 1.1, weight of 68.6 ± 4.2 kg, and height of 175.2 ± 4.7 cm. (Weight was measured on a balance-beam scale with the subject dressed in light clothing, and height was assessed using a stadiometer). Subjects represented varsity (N = 6), second varsity (N = 4), and third varsity (N = 6). The average number of years in the sport of rowing was 3.2 ± 1.2. There is no specific weight criterion for heavyweight rowers, and they do not weigh in before a race. (This is in contrast to lightweight rowers, who must each weigh 59 kg or less and are required to weigh in before a race).

The rowers trained throughout the school year. Training in the late fall and winter involved workouts on the rowing ergometer and weight lifting along with general conditioning activities. With warmer weather in the spring, training resumed on the water and anaerobic conditioning was progressively emphasized. Subjects spent an average of 12 hr per week on the water and 2 hr per week weight training. The mean 2,500-m rowing ergometer (concept II) score was 9:59 ± 0.3 min, with a range of 9:39–10:45 min (elite score would be < 9:10 min).

Subjects gave their written consent to participate in this study, which was approved by the University of Pennsylvania’s Committee on Studies Involving Human Beings.

Dietary Intake

To assess dietary intake, a 5-day food record was used that included 3 weekdays and 2 weekend days. The 5 days represented a typical training week prior to competition. There has been extensive discussion in the literature regarding the strengths and weaknesses of records and recalls for periods ranging from 24 hr to 7 days. There is a general consensus that none of these measures is totally satisfactory (1). However, Basiotis and colleagues (1) have shown that as few as 3 days of records are sufficient to estimate habitual energy intake to within 10% of the actual values (in groups as small as 13 persons).

Instructions for completing the food records were given verbally and in writing by a nutritionist (Dr. Steen). Athletes were asked to record the types and amounts of all foods and fluids that they consumed. The records were reviewed in detail with each subject upon completion (at the end of 5 days) by the nutritionist. Portion sizes were illustrated with the aid of measuring cups, glasses, bowls, and food items.

Diet records were analyzed for energy and nutrient intake (with and without supplements) using the University of Massachusetts Computerized Nutrient Data Bank (MNDB). The MNDB is a database including in excess of 6,000 food items with information on 53 different components for each item. Data sources include the United States Department of Agriculture (USDA), food composition
tables from other countries, food manufacturers, the scientific literature, and recipe formulations. The MNDB has been used extensively to process dietary analysis, by persons ranging from scientific investigators at universities to commercial food service companies.

In addition to energy intake over the 5 days, the following nutrients were analyzed: carbohydrate; protein; total fat; vitamins A, C, and B.<sub>6</sub>, thiamin, riboflavin, and niacin; and the minerals iron, zinc, magnesium, calcium, phosphorous, potassium, and sodium. Percentages of calories from total fat, protein, carbohydrate, and alcohol were determined. Total grams and grams per kilogram body weight were calculated for protein and carbohydrate. Both caloric and nutrient intake were compared to the Recommended Dietary Allowances (RDAs) (4).

Further analysis was performed to evaluate the energy and macronutrient content of the preevent meal eaten the evening prior to a race and for the meal consumed 2 hr prior to the race.

**Results**

As shown in Table 1, mean daily caloric intake (over 5 days) was 2,633 ± 449 kcal. On average, 51% of calories were from carbohydrate (4.9 g/kg), 13% from protein (1.4 g/kg), and 36% from fat. None of the rowers consumed alcohol during the 5 days evaluated.

Analysis of micronutrient intake was performed without supplements, since only one rower was taking a multivitamin and she met the RDA without the supplement. As shown in Figures 1 and 2, all of the rowers met 100% of the RDA for vitamins A and C, thiamin, riboflavin, niacin, and folate. Only 70% and 80% of rowers, however, met 100% of RDA for vitamin B.<sub>6</sub> and B.<sub>12</sub>, respectively. All rowers met 100% of the RDA for phosphorous but showed suboptimal intakes for the minerals calcium, magnesium, iron, and zinc. When compared to two-thirds of the RDA, calcium and zinc intake were still inadequate for 6% and 19%, respectively. Sodium intake averaged 3,191 ± 600 mg and potassium was 3,260 ± 630 mg (NA:K ratio = .98).

| Table 1 Calorie and Macronutrient Intake of Collegiate Female Heavyweight Rowers |
|----------------------------------|--------|---|---|
| **Calories**                     | 2,633  | 449 | 2,025–3,858 |
| Carbohydrate (g)                 | 337    | 68  | 220–532     |
| (51%)                           |        |     |             |
| Protein (g)                      | 88     | 15  | 63–118      |
| (13%)                           |        |     |             |
| Fat (g)                          | 104    | 25  | 66–160      |
| (36%)                           |        |     |             |

*Note*. Number in parentheses is percentage of total calories derived from the macronutrient.
As shown in Figure 3, average composition of the meal consumed the evening prior (15 hr) to a race was 1,270 kcal (range: 561–2,684 kcal), with 48% of calories derived from carbohydrate, 37% from fat, and 15% from protein. Carbohydrate intake was 2.4 g/kg. The pre-event meal consumed 2 hr before the race provided 335 kcal (range: 172–560 kcal), with 66% of calories derived from carbohydrate, 12% from protein, and 22% from fat. Carbohydrate intake was 0.8 g/kg.

**Discussion**

Endurance athletes undertake daily high-intensity training to maximize athletic performance. This high-intensity training requires muscle glycogen as a substrate, and muscle glycogen has been shown to limit endurance capacity (2, 7, 10, 13). Therefore, athletes presumably must replenish their muscle glycogen stores daily to prevent progressive glycogen depletion (13).

It has been recommended that endurance athletes consume 60–70% of their calories from carbohydrate (8–10 g/kg), but analyses of athletes’ diets show that they typically consume low to moderate carbohydrate diets, deriving 45–55% of calories from carbohydrate. In the current study, rowers consumed only 51% of calories from carbohydrate (337 g carbohydrate/day; 4.9 g/kg). This is similar
Female Rowers

Figure 2 — Mineral intake of female heavyweight rowers during the sprint racing phase of the season.

Figure 3 — Preevent meal the evening and morning before a race in female heavyweight rowers.

to an earlier survey (14) which reported that female rowers consumed 46% of calories from carbohydrate.

Simonsen and colleagues (13) reported that consumption of 5 g carbohydrate/kg body weight was not associated with glycogen depletion or impairment during rowing training. However, the authors concluded that a diet providing 10 g carbohydrate/kg body weight promoted greater muscle glycogen content and greater power output during training than did one containing 5 g carbohydrate/kg body weight.
The majority of rowers (63%) in this study consumed less than 5 g carbohydrate/kg body weight. Only 25% consumed more than 55% of calories from carbohydrate, while 63% consumed greater than 35% of calories from fat. Foods such as salad dressing, mayonnaise, cream sauces, cakes, cookies, and chips contributed to their high fat intake as well as to a dietary cholesterol intake of 320 ± 85 mg/day. Given the rowers’ training regimen, it appears that they would have benefitted from increasing dietary carbohydrate consumption (to promote optimal glycogen storage) while lowering their intake of fat.

Although there was a wide range of energy intake (2,025–3,858 kcal), mean intake was only 500 kcal higher than the RDA of 2,100 kcal based on age and sex. Given the duration and intensity of daily workouts, one would predict caloric needs to be closer to 3,000 kcal/day for these athletes. Van Erp-Bart and colleagues (14) reported an average intake of 3,141 calories in 8 female rowers of similar age (23 years) and weight (69.8 kg) as the rowers in this study.

It is possible that the rowers underreported dietary intake (3). Subjects were well trained on how to keep food records, and the records were reviewed by the nutritionist with each rower. However, systematic underreporting may have occurred.

Micronutrient intake was generally adequate. However, intakes of B6, B12, calcium, and zinc were inadequate (less than two-thirds the RDA) for 6% to 11% of subjects. A low intake of dairy foods, beef, and poultry may have contributed to inadequate intake of these nutrients. Principal sources of protein reported by rowers were tuna fish, cheese, and frozen yogurt. Even with the consumption of cheese and yogurt, calcium intake still fell short of the recommended 1,200 mg/day. To boost nutrient density, rowers were given information after the study about foods rich in these micronutrients and were instructed on how to incorporate them into their training diets. Special emphasis was placed on calcium and B6.

The composition of the preevent meal the evening before the race was lower in carbohydrate and higher in fat than recommended. Only 37% of rowers consumed more than 50% of kcal from carbohydrate, and 62% consumed more than 30% kcal from fat. Fried mozzarella sticks, macaroni and cheese, pasta with cream sauce, chicken salad, and chocolate cake were some of the most frequently reported foods. Optimal carbohydrate intake would be closer to 5 g/kg for this meal.

The preevent meal was eaten by 63% of the rowers 2 hr before the race. Reasons given for not consuming breakfast included lack of time (N = 1), used time to sleep (N = 3), and concern about gastrointestinal distress during the race (N = 2). The most popular preevent meal was a bagel with cream cheese, which provided 53% kcal from fat and 36% from carbohydrate. Liquids were ingested by only 6 of the rowers, and beverage choices included coffee with cream (N = 3), juice (N = 2), and water (N = 1). On average, the meal provided 335 kcal and 0.8 g carbohydrate/kg body weight. It is recommended that 2 g carbohydrate/kg body weight be consumed 2 hr prior to competition (12). For those rowers concerned about gastrointestinal upset, carbohydrate beverages or a liquid meal can be encouraged. At the minimum, water should be consumed to ensure hydration.

These results suggest that female heavyweight rowers would benefit from nutritional counseling that provides strategies for increasing complex carbohy-
drates and foods rich in calcium, zinc, B₆, and B₁₂ while reducing dietary fat. Guidelines for adequate fluid intake daily and prior to competition are also essential to promote peak performance.

References


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