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Nutritional Practices of Extreme Endurance Swimmers the Marathon-Swim in the Lake of Zurich 2006

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Abstract: This study was conducted to investigate the nutritional habits of extreme endurance swimmers before, during and after long distance swimming in open water. Athletes had to complete a questionnaire about their nutrition before, during and after the race. In the 4 weeks before the race, 50% ingested a protein rich diet, but 42% followed no special diet. Sixteen percent consumed ergogenic supplements, 66% consumed vitamins and 75% minerals. The day before the start of the race, 83% accomplished a carbo-loading. During the race, 20 different solid food and 12 beverages were consumed. Mainly bananas (75%) and carbohydrate gels (66%) were eaten, whilst isotonic sport drinks (92%) and water (42%) were the main beverages. After the race, 26 different solid food and 10 beverages were consumed. Rice (58%), chocolate (50%), vegetables (50%) and bananas (50%) were preferred; water (58%) and isotonic sport drinks (33%) were the main beverages. Extreme endurance swimmers in the Marathon-Swim in the lake of Zurich followed preferentially a protein-rich diet in the 4 weeks before the race. During the race, they consumed preferably a carbohydrate-rich nutrition (bananas, carbohydrate gels) and drank isotonic sports drinks. After the race, they preferred carbohydrate-rich nutrition and drank water.

Key words: Nutrition, diet, aquatic sport, ultra endurance

Introduction

Adequate energy and nutrient intake is essential to perform in endurance sport. There is abundant literature about nutritional practices in endurance athletes, namely in road cyclists (Martin *et al*., 2002; Garcia-Roves *et al*., 1998; Garcia-Roves *et al*., 2000; Saris *et al*., 1989; Vogt *et al*., 2005), in distance runners (Kruseman *et al*., 2005; Onywera *et al*., 2004; Tanaka *et al*., 1995), and in triathletes (Frentsos and Baer, 1997; Nogueira and Da Costa, 2004). Apart of endurance athletes, eating behaviours are described in figure skaters (Jonnalagadda *et al*., 2004; Ziegler *et al*., 2002), in volleyball players (Beals, 2002; Papadopoulou *et al*., 2002) and in soccer players (Iglesias-Gutierrez *et al*., 2005; Schokman *et al*., 1999).

In aquatic sports, food habits in swimmers (Barr and Costill, 1992; Berning *et al*., 1991), in surfers (Felder *et al*., 1998), and in aquatic athletes (Farajian *et al*., 2004) are investigated. Little is known about nutritional behaviour of extreme endurance athletes competing in ultra distance races, especially in cycling and running (Eden and Abernethy, 1994; Eisinger *et al*., 1994; Lindeman, 1991; Singh *et al*., 1993). No literature is available about nutrient intake and eating behaviours in long distance swimmers. The aim of our study is to investigate the nutritional practices of extreme endurance swimmers in the Marathon-Swim in the Lake of Zurich in 2006.

Materials and Methods

Subjects: All solo swimmers of the 19th occasion of the Marathon-Swim from Rapperswil over 26.4 km to Zurich in the Lake of Zurich, Switzerland, were contacted by a separate newsletter from the organizer 3 months before the race and asked to participate in the study. Eleven male and 11 female swimmers from 11 different countries (USA, Switzerland, Hungary, India, Italy, France, Estonia, UK, Sweden, Germany, New Zealand) intended to start. All athletes entered the race, 9 women and all men finished within the time limit of 12 hours. Five men and 7 women entered the investigation. They all gave their informed written consent. From our subjects, all male (35.4 ± 10.8 years, 81.0 ± 11.9 kg, 180 ± 6 cm, BMI 24.9 ± 3.3 kg/m^2) and all female (37.1 ± 5.6 years, 75.2 ± 13.9 kg, 169 ± 4 cm, BMI 25.9 ± 5.4 kg/m^2) swimmers finished the race within the time limit. The male athletes trained for 13 ± 10 hours per week and had an experience of 13 ± 10 (0 to over 50) races of 24 hours and more, the females trained for 10 ± 5 hours a week and had finished 6 ± 15 races (0 to 40) of 24 hours and more. Several of the females were successful finishers of the Channel swimming Dover-Calais. Two female swimmers were vegetarians.

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The race: In the morning of August 6th 2006 at 07:00 a.m., the solo swimmers started in Rapperswil, followed by their support boats. At the start, water temperature was at 22° Celsius and air temperature at 17.3° Celsius. The sky was cloudy, the lake flat and no wind was blowing. During the day, the temperature rose to a maximum of 20.3° Celsius. A harsh wind with heavy rain from the west disturbed both the swimmers and the support boats during the whole race.

Nutrition during the race: In the morning before the swimmers started, the organizer offered to all athletes a breakfast with bread, jam, butter, honey, muesli, coffee, tea and milk. During the race, every swimmer was followed by his own support crew. The crew provided the athlete with all the nutrition required during the race. At the finish, the organizer offered a huge buffet with tofu, rice, noodles, vegetables, potatoes, beans, green salad, cake, chocolate, different fruits, roasted pine nuts, muesli, chocolate and vanilla cream with blackberries and cream, soup, coffee, milk, tea and water.

Questionnaires: All participants of the race were contacted by a newsletter 6 weeks before the race by the organizer and received a questionnaire to fill in their nutritional habits before, during and after the race. They were invited to report about their intake of energy rich substrates, fluids, ergogenic supplements, vitamins and minerals. On page 1 they had to fill in personal data including training, race experience and special nutritional habits like vegetarianism and food allergies. On the second page, nutrition in the 4 weeks before the race (special diet, ergogenic supplements, vitamins and minerals), on page 3 the nutrition the day before the start of the race (special diet, beverages, ergogenic supplements, vitamins and minerals), on page 4 the nutrition during the race (solid food, beverages, ergogenic supplements, vitamins and minerals), on page 5 the nutrition after the race (solid food, beverages, ergogenic supplements, vitamins and minerals). Apart from an abundant choice of products and substances to mark with a cross, they had enough space to write their own comments. After the race, they sent their completed questionnaire by fax, postal letter or e-mail to the investigator.

Results

In the 4 weeks before the race (Table 1), 6/12 (50%) athletes ingested a protein-rich diet, but 5/12 (42%) followed no special diet. Two out of twelve swimmers (16%) consumed 2 different ergogenic supplements. Eight out of twelve (66%) swimmers consumed 3 different vitamins, mainly a multi-vitamin product (7/8). Four different minerals were used by 9/12 (75%) athletes, where magnesium was the preferably consumed mineral (5/12). The day before the start of the race (Table 2), 10/12 swimmers (83%) accomplished a carbo-loading. Mainly, multi-vitamin products (7/12, 58%) and a multi-mineral product (5/12, 42%) as well as magnesium (5/12, 42%) were ingested. During the race, 20 different solid food and 12 beverages were consumed (Table 3). For preference, bananas (9/12, 75%) and carbohydrate gels (8/12, 66%) were eaten; isotonic sports drinks (11/12, 92%) and pure water (5/12, 42%) were the main beverages. No athlete used ergogenic supplements during the race, whilst 2/12 (17%) consumed a multi-vitamin product, magnesium and a multi-mineral product. After the race, 26 different solid food and 10 beverages were consumed. Rice

Table 1: Diet and supplementation in the 4 weeks before the swim

Special diet		
Protein-rich nutrition	6	(50%)
Carbohydrate-rich nutrition	1	(8%)
Carbohydrate-poor nutrition	1	(8%)
No special diet	5	(42%)
Ergogenic supplements		
Rojal jelly	1	(8%)
Concentrate of amino acids	1	(8%)
No intake of ergogenic supplements	10	(83%)
Vitamins		
Multi-vitamin	7	(58%)
Vitamin C	2	(17%)
Vitamin B	1	(8%)
No intake of vitamins	4	(33%)
Minerals		
Magnesium	5	(42%)
Multi-mineral	3	(25%)
Calcium	3	(25%)
Iron	2	(17%)
No intake of minerals	3	(25%)

Table 2: Diet and supplementation the day before the race

Special diet		
Carbohydrate-rich nutrition	10	(83%)
Protein-rich nutrition	1	(8%)
Fat-rich nutrition	1	(8%)
No special diet	1	(8%)
Ergogenic supplements		
L-Carnitine	2	(17%)
Concentrate of amino acids	1	(8%)
Royal jelly	1	(8%)
No intake of ergogenic supplements	8	(66%)
Vitamins		
Multi-vitamin	7	(58%)
Vitamin C	3	(25%)
Vitamin B	2	(17%)
Vitamin E	1	(8%)
No intake of vitamins	3	(25%)
Minerals		
Multi-mineral	5	(42%)
Magnesium	5	(42%)
Calcium	4	(33%)
Iron	2	(17%)
Zinc	1	(8%)
No intake of minerals	3	(25%)

Table 3: Nutrient intake and supplementation during the race

Solid food		
Bananas	9	(75%)
Carbohydrate gel	8	(66%)
Chocolate	3	(25%)
Dates	2	(17%)
Cheese	2	(17%)
Energy bars	2	(17%)
Corn	1	(8%)
Crispbread	1	(8%)
Fruit quark	1	(8%)
Pasta	1	(8%)
Yoghurt drink	1	(8%)
Gingerbread	1	(8%)
Marzipan	1	(8%)
Chicken	1	(8%)
Bread	1	(8%)
Noodles	1	(8%)
Mars®	1	(8%)
Raisins	1	(8%)
Peach	1	(8%)
Beverages		
Isotonic sports drink	11	(92%)
Water	5	(42%)
Coca Cola®	2	(17%)
Chi®	1	(8%)
Ensure®	1	(8%)
Protein drink	1	(8%)
Bouillon	1	(8%)
Milk	1	(8%)
Beer	1	(8%)
Ice Tea	1	(8%)
Coffee	1	(8%)
Orange juice	1	(8%)
Ergogenic supplements		
No intake of ergogenic supplements	12	(100%)
Vitamins		
Multi-vitamin	2	(17%)
Vitamin B	1	(8%)
Folic acid	1	(8%)
Vitamin E	1	(8%)
No intake of vitamins	9	(75%)
Minerals		
Magnesium	2	(17%)
Multi-mineral	2	(17%)
Zinc	1	(8%)
Calcium	1	(8%)
No intake of minerals	8	(66%)

(7/12, 58%), chocolate (6/12, 50%), vegetables (6/12, 50%) and bananas (6/12, 50%) were preferred. Pure water (7/12, 58%) and isotonic sport drinks (4/12, 33%) were the main beverages (Table 4). No athlete consumed ergogenic supplements after the race; for preference, multi-vitamin (4/12, 33%) and magnesium (4/12, 33%) were ingested as vitamins and minerals.

Discussion

Our investigation reveals some astonishing results, which do not correspond to the current opinion of nutrition in sport. In the 4 weeks of the race, only 8% of the successful extreme endurance swimmers paid attention to a carbohydrate-rich nutrition, but the day before the start of the race, 83% of the successful finishers followed a carbo-loading. Choosing a protein-rich diet was the main nutritional behaviour (50%) in the preparation of the race. During and after the race, carbohydrate-rich products were preferred. But apart from this kind of products, a huge variety of different food was ingested. In general, it is recommended in endurance sport to drink a carbohydrate-electrolyte beverage during and after exercise, which was consumed by 92% of the swimmers during and by 33% after the race. But water was the main beverage in 58% of the athletes after the race.

Nutrition before and during extreme endurance race: In general, athletes covering long distances need a variety of high-calorie foods in order to maintain performance in extreme endurance (Gabel *et al.*, 1995). Breakfast, lunch and dinner are not only required in non-athletic persons, but also in competitive athletes as the main sources of energy intake (Ziegler *et al.*, 2002). The eating pattern of professional road cyclists consists of several snacks throughout the race or training. Breakfast, a meal 1 hour after performance, and supper are the common eating behaviour (Garcia-Roves *et al.*, 2000). These extreme endurance athletes also ingested their calories the morning before the race, during the swim, and after the race.

Energy rich substrates: Intake of energy before, during and after physical performance is essential in order to maintain performance during an extreme endurance race. The nutritional considerations of the extreme endurance athlete are focussed on proper calorie and nutrient intake during training as well as adequate energy and fluid replacement during competition to maintain optimal performance (Applegate, 1991). The duration of a performance seems to be crucial for successful performance. Long- and middle-distance runners show a significantly higher energy and macronutrient intake than other track-and-field athletes (Sugiura *et al.*, 1999) and it has been shown that an increase in volume appears to result in an increased consumption of the athlete's usual diets (Barr and Costill, 1992).

It is well known that carbohydrate-rich products are recommended before (Applegate, 1991; Brown, 2002; Hargreaves *et al.*, 2004; Lambert and Goedecke, 2003; Maughan *et al.*, 1997; Peters, 2003; Williams, 1995), during (Applegate, 1991; Brown, 2002; Lambert and Goedecke, 2003; Peters, 2003) and after (Lambert and Goedecke, 2003; Peters, 2003; Williams, 1995) physical performance in order to fill (Applegate, 1991; Hargreaves *et al.*, 2004; Peters, 2003; Williams, 1995) or refill (Garcia-Roves *et al.*, 1998; Lambert and Goedecke, 2003; Peters, 2003; Roy *et al.*, 2002) the carbohydrate

Table 4: Nutrient intake and supplementation after the race

Solid food		
Rice	7	(58%)
Chocolate	6	(50%)
Vegetables	6	(50%)
Bananas	6	(50%)
Noodles	3	(25%)
Tofu	3	(25%)
Chocolate pudding	3	(25%)
Tomatoes	3	(25%)
Salad	3	(25%)
Potatoes	2	(17%)
Bread	2	(17%)
Fish	2	(17%)
Yoghurt	2	(17%)
Biscuits	2	(17%)
Carrots	2	(17%)
Oranges	2	(17%)
Kiwi	2	(17%)
Peach	2	(17%)
Cake	1	(8%)
Meat	1	(8%)
French fries	1	(8%)
Cheese	1	(8%)
Cucumbers	1	(8%)
Chips	1	(8%)
Dried fruits	1	(8%)
Tofu	1	(8%)
Beverages		
Water	7	(58%)
Isotonic sports drink	4	(33%)
Coca Cola®	3	(25%)
Milk	2	(17%)
Beer	2	(17%)
Coffee	2	(17%)
Chi®	1	(8%)
Champagne	1	(8%)
Soup	1	(8%)
Orange juice	1	(8%)
Ergogenic supplements		
No intake of ergogenic supplements	12	(100%)
Vitamins		
Multi-vitamin	4	(33%)
Vitamin B	1	(8%)
Vitamin C	1	(8%)
Vitamin E	1	(8%)
No intake of vitamins	7	(58%)
Minerals		
Magnesium	4	(33%)
Multi-mineral	3	(25%)
Calcium	2	(17%)
Iron	1	(8%)
No intake of minerals	5	(42%)

store before and after exercise. Although these ultra swimmers ingested carbohydrate-rich products during and after the race, they did not follow a carbohydrate-rich nutrition for the 4 weeks before, but rather, only the day before the race.

During physical performance, the highest proportion of energy rich substrates should derive from the intake of carbohydrates independent of the kind of sport (Burke *et al.*, 1991; Burke, 2001; Burke *et al.*, 2003; Eden and Abernethy, 1994; Garcia-Roves *et al.*, 1998; Onywera *et al.*, 2004; Saris *et al.*, 1989; Vogt *et al.*, 2005). In extreme endurance, the carbohydrate calories derive from simple sugars, cookies, sweetened drinks and candy (Gabel *et al.*, 1995). Also these extreme endurance athletes preferred carbohydrate-rich products during performance, mainly from bananas, carbohydrate gels and isotonic sports drinks during exercise. They preferred concentrates of nutrition like carbohydrate gels during the race. We presume that these products can easily be eaten and swallowed during swimming, so that the swimmer does not have a long break to feed during swimming.

Fluid intake: In general, it is recommended for endurance athletes to drink a solution of carbohydrates and electrolytes during performance (Saris *et al.*, 1989). These athletes drank preferentially isotonic sports drinks during and after the swim, but after the swim, more water than isotonic sports drink was preferred.

Supplementation with ergogenic supplements, vitamins and minerals: In our investigation, the 4 weeks before the race, the athletes consumed several different ergogenic supplements, minerals and vitamins. Also the day before the race, during and after a stage, ergogenic nutrients were ingested. Endurance athletes often use other nutritional substances and practices in attempts to obtain a competitive edgy by enhancing energy utilization and delaying the onset of fatigue (Williams, 1992).

Intake of ergogenic supplements is widespread in athletes (DesJardins, 2002; Huang *et al.*, 2006; Maughan *et al.*, 2004). About 30% to 60% of all athletes consume supplementation of vitamins or minerals, whilst women more often use these products compared to men (Nieper, 2005), which could not be confirmed in another study (Sundgot-Borgen *et al.*, 2003). About 75% of female athletes and 55% of male athletes use ergogenic supplements (Nieper, 2005). Depending upon the studies, the percentage varies from 6% to 100% (Greandjean, 1983; Kim and Keen, 1999; Nieman *et al.*, 1989; Nieper, 2005; Peters and Goetzsche, 1997; Sobal and Marquart, 1994; Sundgot-Borgen *et al.*, 2003; Worme *et al.*, 1990). Professional athletes more often consume ergogenic supplements than recreational athletes (Huang *et al.*, 2006; Sobal and Marquart, 1994). Adolescent athletes already consume ergogenic supplements (DesJardins, 2002; Johnson and Landry, 1998), but with increasing age more supplements will be consumed (Nieman *et al.*, 1989).

Before, during and after the race, practically no ergogenic supplements were used by the described athletes, but especially multi-vitamin, magnesium and multi-mineral. The results for vitamins and minerals are not different from the literature. In some cases up to three different supplements are used (Greandjean,

1983; Huang *et al.*, 2006; Nieman *et al.*, 1989; Nieper, 2005). Those most often used are combined products (Greandjean, 1983; Nieper, 2005) followed by minerals, vitamin C, iron, zinc, vitamin E, vitamin B-complex, niacin, folic acid, creatine, concentrates of amino acids, calcium and vitamin A (Greandjean and Ruud, 1994; Huang *et al.*, 2006; Kim and Keen, 1999; Nieman *et al.*, 1989; Sobal and Marquart, 1994; Sundgot-Borgen *et al.*, 2003). In the case of vitamin B-complex, vitamin C and iron, athletes frequently ingest more than the recommended daily intake (Greandjean, 1983).

Conclusion: Extreme endurance swimmers in the Marathon-Swim in the lake of Zurich followed preferentially a protein-rich diet in the 4 weeks before the race. During the race, they consumed preferably carbohydrate-rich nutrition (bananas, carbohydrate gels) and drank isotonic sports drinks. After the race, they preferred carbohydrate-rich nutrition and drank water. The only difference in nutrition in these extreme endurance swimmers is the tendency for a protein-rich nutrition in the preparation for the race. During and after the race, carbohydrate-rich nutrition was preferred as recommended in sports nutrition.

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