International Journal of Sport Nutrition and Exercise Metabolism, 2011, 21, 347-351
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Feeding Strategies of a Female Athlete During an Ultraendurance Running Event

Siobhan T. Moran, Christine E. Dziedzic, and Gregory R. Cox

The aim of this case study was to describe the race nutrition practices of a female runner who completed her first 100-km off-road ultraendurance running event in 12 hr 48 min 55 s. Food and fluid intake during the race provided 10,890 kJ (736 kJ/hr) and 6,150 ml (415 ml/hr) of fluid. Hourly reported carbohydrate intake was 44 g, with 34% provided by sports drink. Hourly carbohydrate intake increased in the second half (53 g/hr) compared with the first half (34 g/h) of the race, as the athlete did not have access to individualized food and fluid choices at the early checkpoints and felt satiated in the early stages of the race after consuming a prerace breakfast. Mean sodium intake was 500 mg/hr (52 mmol/L), with a homemade savory broth and sports drink (Gatorade Endurance) being the major contributors. The athlete consumed a variety of foods of varying textures and tastes with no complaints of gastrointestinal discomfort. Despite thinking she would consume sweet foods exclusively, as she had done in training, the athlete preferred savory foods and fluids at checkpoints during the latter stages of the race. This case study highlights the importance of the sports nutrition team in educating athletes about race-day nutrition strategies and devising a simple yet effective system to allow them to manipulate their race-day food and fluid intake to meet their nutritional goals.

***Keywords**:* carbohydrate, fluid intake, sodium

Ultraendurance running events are becoming increasingly popular among recreational and elite competitors. Athletes participating in these events are faced with a unique set of nutritional challenges as they compete for long periods of time and encounter extremes in environmental conditions and terrain. The North Face 100 (NF100) is one such event, held in the Blue Mountain region of New South Wales, Australia (www.thenorthface.com.au/100). Because of the logistical issues in undertaking research protocols that reflect such events, nutritional advice provided to these athletes requires sports nutrition professionals to interpret current sports nutrition guidelines for endurance activities. Furthermore, in offering advice, the sports nutrition professional must consider issues that will influence the athlete's acceptance of foods and fluids throughout the event, as well as logistical issues such as access and portability of preferred options (Burke, 2002).

There are several nutritional priorities on race day for athletes undertaking ultraendurance running races. Current recommendations suggest consumption of 1–4 g carbohydrate/kg body mass in the 1–4 hr before exercise (Burke, Cox, Cummings, & Desbrow, 2001) to optimize muscle and liver glycogen stores. During the event, the athlete's nutritional priorities are to drink appropriately to maintain euhydration, consume adequate carbohydrate to maintain blood sugar levels and provide an alternative fuel for exercising muscles, and incorporate foods, fluids, or supplements providing sodium (Burke, 2002).

Despite several studies reporting food- and fluid-intake practices of male athletes during single-day footraces (Fallon, Broad, Thompson, & Reull, 1998; Glace, Murphy, & McHugh, 2002) and multiple-day footraces (Eden & Abernethy, 1994; Rontoyannis, Skoulis, & Pavlou, 1989), studies have failed to report intakes of female athletes during such events. Therefore, the aim of this case study was to provide a detailed outline of the food and fluid intake of a recreational female athlete undertaking an ultraendurance footrace.

The Athlete

The subject was a 25-year-old recreational female athlete (body mass 48.0 kg, height 156.5 cm) who was experienced at Olympic-distance triathlons and half-marathon races. She made a commitment 3 months before the 2010 NF100 to undertake the event, having never completed an ultraendurance running race before. Through informal conversations with the first and second authors, the subject requested specific advice about prerace and race nutrition strategies. She provided written permission for publication of the case study, having read the manuscript before the original submission date, which conforms to the principle approved by the Human Ethics Committee of the Australian Institute of Sport.

The authors are with Sports Nutrition, Australian Institute of Sport, Belconnen, ACT, Australia.

Before deciding to undertake NF100, the subject was training at least once daily. This involved a combination of swimming, cycling, and running sessions to accommodate daily work commitments. Running sessions were slowly progressed from 3–4 to 7–10 per week over a 3-month period before the race. Duration of training sessions was also increased, with two long runs over 4 hr included each week in the final month. Furthermore, the program was adapted to incorporate more challenging terrain to reflect that of the course, although the subject did not include any stair climbing in her training program.

During the 3 months before the race, the subject lost approximately 3.7 kg, with an associated decrease in sum of seven skinfolds from 80.0 mm to 58.3 mm. She reported changing her daily food and fluid intake in the 2 months before the event to "eat more healthily." More specifically, she reported eating fewer energy-dense snacks such as chocolate and reducing the size of her midday meal.

Race Information

NF100 is a challenging all-terrain footrace held in Australia. Athletes are required to traverse mountainous terrain including a large number of steps and two cliff-face descents via Tarros ladders. There were five race checkpoints along the course (at 17, 38, 54, 67, and 89 km), with a small variety of fluids and foods available for athletes. These items were limited to water, premade sports drink, fruit, candy, muesli cookies, and a savory snack (Kraft Vegemite Snackabouts). Support crews were able to provide food and fluid at Checkpoints 3, 4, and 5. In 2010, 553 solo runners (459 men and 94 women) completed the event with an average race time of 17 hr 29 min 23 s. On race day, temperatures ranged from 3.8 to 15.4 °C at the start/finish point according to www.weatherzone.com.au. The subject in this case study completed the course in 12 hr 48 min 55 s to finish third in the female solo division (26th overall solo competitor).

Overview of Nutrition Plan

Dietary-Collection Methodology

On the day of the event, a sports dietitian (S.M.) was present to record all foods and fluids consumed. At three of the five checkpoints a record was kept of all food and fluid consumed, as well as foods and fluids taken by the subject for the next stage of the race. There was no support-team access at Checkpoints 1 and 2, so the athlete carried all food and sports drink that had been planned for her to consume between the start of the race and Checkpoint 3. The support team then clarified with the athlete which foods she had consumed when she arrived at Checkpoint 3 and whether any additional foods or fluids provided at the earlier checkpoints had been consumed. Within 24 hr of the race finish, the subject was asked to verify her intake and note any discrepancies against the food record. Any foods she had consumed other than that provided by the support team, as well as any foods that were lost en route, were noted.

Before the race, all foods and fluids for the subject were packaged by the support team into single-serving sizes for easy access and identification. Using nutrition information panels, the serving size was approximated and the nutrition content determined. All individual packs were labeled with the amount of carbohydrate (g) rounded to the nearest 5 g. If a product was deemed high in sodium, this was marked on the packaging using a large red star. At Checkpoints 3–5, foods and fluids were placed on a large mat divided into sweet and savory sections, so the subject could easily identify the foods available. The subject carried a 3-L-capacity camel pack during the race. The fluid (sports drink) contained in the camel pack was made up to the subject's preferred concentration and measured by filling it with a known-volume drink bottle at each checkpoint.

Total energy (kJ), carbohydrate (g), fat (g), protein (g), dietary fiber (g), and sodium (mg) of all foods and fluids were estimated using FoodWorks Professional Edition, Version 6.0.2539 (Xyris Software, Brisbane, Australia). Data analysis was performed by a sports dietitian (S.M.). Food-composition data were compiled from Nuttab 95; AusFoods; Australian AusNut, and nutritional information, from food manufacturers entered into the database. On completion of analysis, data entries were verified against the original records provided by the sports dietitian at the time of collection.

Nutrition Plan

To minimize gastrointestinal discomfort and meet the subject's expectations, the timing, amount of carbohydrate and sodium, and overall composition of the pre-race meal was individualized (Rehrer, van Kemenade, Meester, Brouns, & Saris, 1992). We recommended that the subject consume her usual carbohydrate-based breakfast 1–4 hr before the race start. In addition, specific foods and fluids were included to increase her carbohydrate, fluid, and sodium intake. A caffeine-containing beverage was also included, because this was part of her typical training breakfast.

In considering the duration and intensity of the event along with the subject's tolerance for food and fluid intake during the race, we suggested a target carbohydrate intake of 40 g/hr (Rodriguez, DiMarco, & Langley, 2009). No specific fluid target was provided to the subject because it is thought that in a cool environment, as was expected, performance and physical well-being may not be affected by body-water losses amounting to 2% of body weight (Coyle, 2004). It was still emphasized that a "regular fluid intake" be consumed throughout the event and that this fluid contain carbohydrate and sodium. Sodium-rich fluids and foods were included to achieve a sodium intake of 500–1,000 mg/hr (Clark, Tobin, & Ellis, 1992).

Implementation and Outcome of the Plan

A prerace breakfast meal comprising rice porridge, sports drink, and coffee was consumed 2 hr before the race, with additional fluids (cola drink) consumed ~30 min before the race start (Figure 1). The prerace meal provided ~1,000 kJ, 57 g carbohydrate (1.1 g/kg), 750 mg sodium, 850 ml fluid, and ~82 mg caffeine (1.7 mg/kg). The carbohydrate content of the preevent meal could be considered relatively low compared with current guidelines (Burke et al., 2001). However, because of the opportunities to consume food and fluid throughout the race, it was felt that familiarity and the subject's gastrointestinal comfort with foods and fluids were the priority. In addition, the subject had undertaken a "modified" carbohydrate-loading program and consumed a carbohydrate-rich meal the night before the event. At her request, caffeinated beverages were made available prerace and at checkpoints as an alternative to other carbohydrate-containing fluids. Caffeine was included not as a performance-enhancing aid but rather as a familiar training beverage choice. The use of concentrated caffeine supplements was not incorporated into the race-day nutrition plan because the subject did not feel comfortable introducing these products during the final stages of training for the race.

Total food and fluid intake during the race provided 10,890 kJ (736 kJ/hr), 558 g carbohydrate (44 g/hr), 6,150 ml fluid (415 ml/hr), and 7,403 mg sodium (500 mg/hr, 52 mmol/L; Figure 1). The subject did not complain of any gastrointestinal discomfort throughout the event, suggesting that foods and fluids consumed during the event were well tolerated. Overall, hourly carbohydrate intake was slightly above the set target of 40 g/hr and similar to that reported in an earlier account of male athletes (42.8 g/hr) during a 24-hr footrace (Fallon et al., 1998). The subject in our case study consumed 34 g/hr during the first half of the race, compared with 53 g/hr during the second half. The difference in carbohydrate intake throughout the event was likely a result of the subject's appetite having been satisfied during the early stages of the event after the prerace meal. Although the prerace meal only provided 1.1 g/kg, this is similar to that previously observed in male subjects competing in a long-distance road cycling event who consumed 1.0 g/kg (Havemann & Goedecke, 2008). In addition, it is probable that limited access to *individualized* food and fluid choices at Checkpoints 1 and 2 further contributed to the lower carbohydrate intake early in the race.

Sweet (Gatorade Endurance) and savory (broth) high-sodium fluids (84 mg/100 ml and 240 mg/100 ml, respectively) were made available to provide a reliable source of sodium, drive thirst, and provide varied taste options. Most of the fluid consumed during the race was carried by the subject in a camel pack and was refilled at each accessible checkpoint. Her intake of sports drink (Gatorade Endurance) remained consistent throughout the race, although, as the race progressed, she asked that it be diluted because the sweetness was becoming less tolerated. In the early stages of the race, the concentration of sports drink was ~5%; this decreased to ~3.5% at the last checkpoint. A total of 3,850 ml of Gatorade Endurance was consumed, providing 2,835 kJ, 189 g carbohydrate, and 2,700 mg sodium. This contributed 26% of total energy intake, 34% of total carbohydrate intake, and 37% and 63% of sodium and fluid intake, respectively. Cola made up a further 14% of total fluid intake (850 ml) and 16% of total carbohydrate intake (91 g). The consumed volume of cola also provided ~83 mg of caffeine throughout the race. The broth (a bouillon cube dissolved in warm water) contributed 20% of the total fluid consumed and provided the greatest amount of sodium (3,000 mg; 41% of total sodium intake) during the race. Together, these three fluids provided 50% of the subject's overall carbohydrate (280 g), 78% of sodium (5796 mg), and 97% of total fluid (5950ml) intake. Of note, the subject did not request water at any stage during the event.

As previously mentioned, a range of solid snack foods was available to the subject throughout the race. Choices offered were based on her regular training foods, as well as others suggested by the sports nutrition team. Sweet foods (such as snack bars, candy, PowerBar Gel Blasts) were consumed more frequently during the early stages of the race, with savory/salty choices becoming more favored as the race progressed (Figure 1). Despite the subject's reliance on candy regularly during longer training sessions, she did not tolerate them well during the race (Figure 1). She had preconceived ideas about the types of foods she would crave and maintained that she would exclusively consume sweet foods. As illustrated in Figure 1, she had a wide range of food flavors, including several savory fluid and food choices. These options were suggested by the sport nutrition team to avoid "flavor fatigue," which may arise when one only consumes sweet-tasting foods and fluids (Burke, 2002).

Sodium intake increased in the latter part of the race, mainly from the intake of the broth solution. Although the subject had not trialed the broth in training, she requested it at Checkpoints 3, 4, and 5 (Figure 1). As the race progressed, she preferred the savory flavor of the broth to the sweet-tasting fluids. Although the etiology of muscle cramps remains unclear, the perception that sodium intake would help resolve cramps also drove the subject to consume salty food and fluids after she complained of calf cramps in the early part of the race. The wide selection of high-sodium fluids and foods provided adequate sodium (52 mmol/L) to meet current sodium-intake guidelines (30–50 mmol/L) suggested for ultraendurance events (Rehrer, 2001).

Reflections

The sports nutrition team played a key role in influencing the variety of foods and fluids offered at checkpoints throughout the race. Despite the subject's intention to rely entirely on sweet-tasting foods and fluids, savory options

Time	05:00	07:00 Race Start	13:15		14:58		16:02		19:48
	Pre-race	(Between start and CP3)	CP3 54km	(CP3-4)	CP4 67km	(CP4-5)	CP5 89km	(CP5-finish)	100km
CHO (g)	58	210	57	75	63	93.2	32	28	
Fluid (ml)	850	1500	750	850	800	750	750	750	
Sodium (mg)	755	1479	1416	864	1188	692	1364	400	

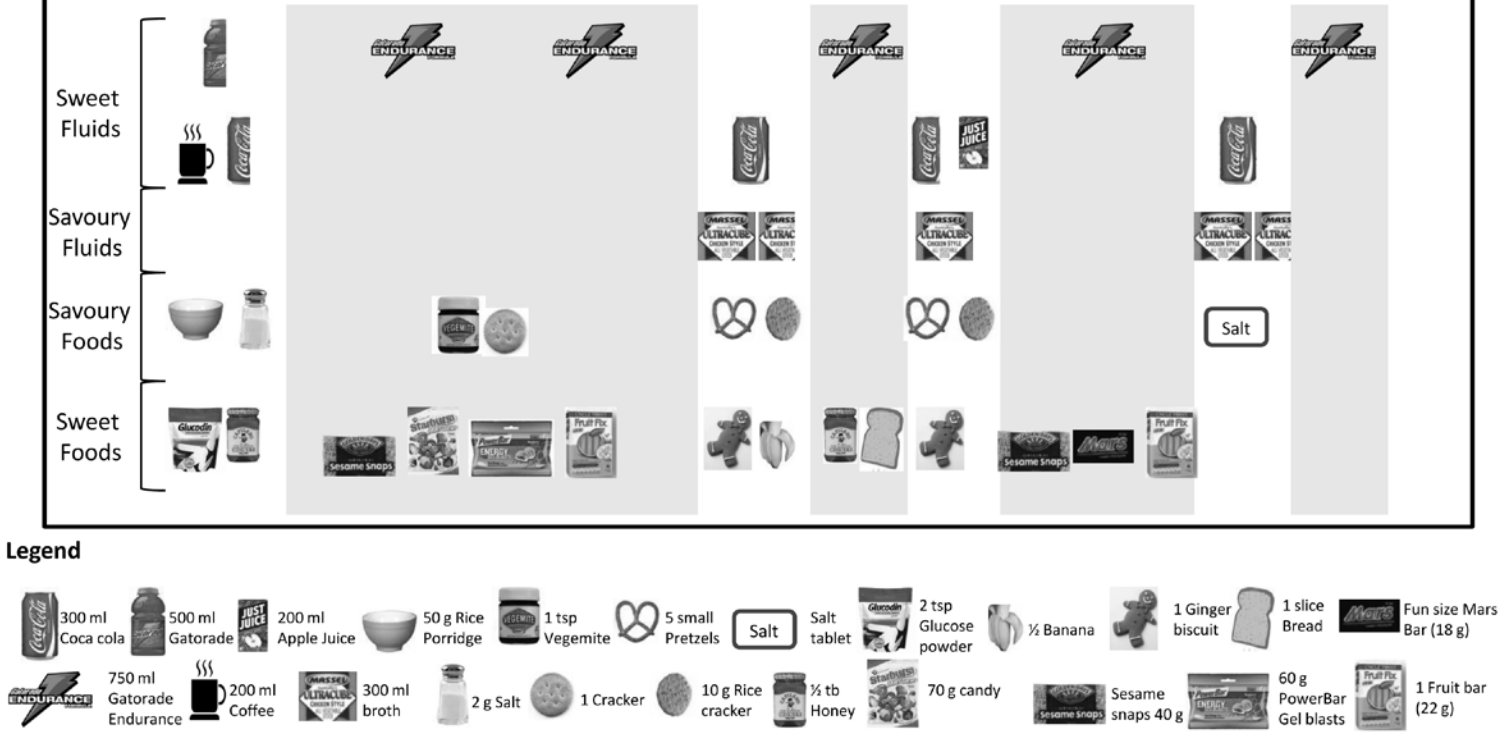

Figure 1 — Timing of food and fluid intake before and during the North Face 100 race.

contributed significantly to her overall intake of carbohydrate, sodium, and fluid. Before the race, the support team educated the subject on fueling for performance. In addition, verbal encouragement was given to increase the amount of food and fluid consumed at each checkpoint, as well as the provision of extra foods in addition to what she chose for each leg of the race. The subject responded well to encouragement when it was related to how it could improve performance, and as the race progressed, she was more responsive to our suggestions. It is likely that she would have failed to meet hourly carbohydrate- and sodium-intake goals had it not been for the variety of foods and fluids provided and the encouragement offered by the sports nutrition team.

The organization of provisions at checkpoints, particularly the labeling of food and fluids, allowed the subject to easily identify her choices. The labeling system provided a simple way to approximate carbohydrate intake for both the subject and the support team, as well as indicate when high-salt options were consumed, which allowed for continual modification of the nutrition plan. It also provided a timely reminder of important nutrients that she needed to consume. The subject's ability to select from a wide range of flavors throughout the race allowed her to maintain a consistent carbohydrate and fluid intake, which was important in determining her eventual success.

Solids and liquids were equally important in providing a source of carbohydrate during this event. This is an interesting observation, because in shorter endurance events athletes have been shown to reduce carbohydrate intake from fluids in cooler race conditions (Cox, Snow, & Burke, 2010). Therefore, in devising a nutrition plan for ultraendurance athletes, it is important to ensure that hourly carbohydrate-intake guidelines can be achieved with a varied hourly fluid intake.

Not having competed in an event such as this before, the athlete's expectations were not set on a top 3 finish but just to "walk as little as possible." She was thrilled with the result and believed that the implementation of the nutrition plan helped maintain her energy levels throughout the race. She felt that muscle pain and cramping were a challenge toward the end of the race rather than fatigue and on reflection commented that more training on stairs would have been beneficial given the tough terrain.

Nutrition strategies during ultraendurance footraces require athletes to become familiar with race-day food and fluid choices during daily training. Although we had limited time for nutrition consultation, the success of our planning was partly achieved by incorporating the athlete's food and fluid preferences in the selection of choices available. Furthermore, careful planning of race-day provisions based on set guidelines is important, but sufficient flexibility should be allowed so the athlete can modify the plan according to his or her tolerance and opportunities for food and fluid intake, as well as the environmental conditions on race day.

Acknowledgments

The authors wish to thank the subject who volunteered for this case study. We would also like to thank the support crew, who willingly assisted with data collection and the provision of foods and fluids on race day.

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