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Feeding strategies of a female athlete contesting an ultraendurance running event.

Key words: carbohydrate, fluid intake, sodium

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Abstract

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 h 48 min 55 sec. Food and fluid intake during the race provided 10 890 kJ (736 kJ/h) and 6150 ml (415 ml/h) 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/h) compared to the first half (34 g/h) of the race, as the athlete did not have access to individualised food and fluid choices at the early checkpoints, and felt satiated in the early stages of the race after consuming a pre-race breakfast. Mean sodium intake was 500 mg/h (52 mmol/L), with a homemade savoury 'stock' 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 savoury 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 the athlete about race-day nutrition strategies and devising a simple, yet effective system to allow the athlete to manipulate her race-day food and fluid intake to meet her nutritional goals.

1 **Introduction**

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

13

14 There are several nutritional priorities on race-day for athletes undertaking ultraendurance
15 running races. Current recommendations suggest athletes consume 1-4 g carbohydrate/kg, 1-4
16 h before exercise (Burke, Cox, Cummings, & Desbrow, 2001) to optimise muscle and liver
17 glycogen stores. During the event, the athlete's nutritional priorities are to 1) drink
18 appropriately to maintain euhydration, 2) consume adequate carbohydrate to maintain blood
19 sugar levels and provide an alternative fuel for exercising muscles, and 3) incorporate foods,
20 fluids or supplements that provide sodium (O'Connor & Cox, 2002).

21

22

23 Despite several studies reporting food and fluid intake practices of male athletes contesting
24 single day foot-races (Fallon, Broad, Thompson, & Reull, 1998; Glace, Murphy, & McHugh,
25 2002) and multiple day foot-races (Eden & Abernethy, 1994; Rontoyannis, Skoulis, &

26 Pavlou, 1989) studies have failed to report intakes of female athletes contesting such events.
27 Therefore, the aim of this case study was to provide a detailed outline of the food and fluid
28 intake of a recreational female athlete undertaking an ultraendurance foot-race.

29

30 **Presentation of the athlete**

31 The subject was a 25 year old recreational female athlete (body mass – 48.0 kg; height –
32 156.5 cm) who was experienced at Olympic distance triathlons and half marathon races. The
33 subject made a commitment three months before the 2010 NF100 to undertake the event,
34 having never completed an ultraendurance running race. Through informal conversations
35 with the first and second authors, the subject requested specific advice about pre-race and
36 race nutrition strategies that could be implemented. The subject provided written permission
37 for publication of the case study having read the manuscript before the original submission
38 date which conforms to the principle that has been approved by the Human Ethics Committee
39 of the Australian Institute of Sport.

40

41 **Personal and training history**

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

49

50 During the three months before the race, the subject lost approximately 3.7 kg, with an
51 associated decrease in sum of seven skinfolds from 80.0 mm to 58.3 mm. The subject
52 reported changing her daily food and fluid intake in the two months before the event to
53 “eating more healthily”. More specifically, she reported eating less energy dense snacks such
54 as chocolate and reducing the size of her mid-day meal.

55

56 **Race Information**

57 NF100 is a challenging all-terrain foot race held in Australia. Athletes are required to traverse
58 mountainous terrain including a large number of steps and two cliff face descents via tarros
59 ladders. There are five race checkpoints (17km, 38km, 54km, 67km and 89km) along the
60 course with a small variety of fluids and foods available for athletes. These items were
61 limited to water, pre-made sports drink, fruit, confectionary, muesli cookies, and a savoury
62 snack (Kraft Vegemite snackabouts). Support crews were able to provide food and fluid at
63 checkpoints 3, 4 and 5. In 2010, 553 solo runners (459 males and 94 females) completed the
64 event with an average race time of 17 h 29 min 23 sec. On race-day, temperatures ranged
65 from 3.8-15.4°C at the start/finish point according to www.weatherzone.com.au. The subject
66 in this case study completed the course in 12 h 48 min 55 sec to finish third in the female solo
67 division (26th overall solo competitor).

68

69 **Overview of Nutrition plan/intervention**

70 **Dietary collection methodology**

71 On the day of the event, a Sports Dietitian (SM) was present to record all foods and fluids
72 consumed. At three of the five checkpoints a record was kept of all food and fluid consumed,
73 as well as foods and fluids taken by the subject for the next stage of the race. There was no
74 support team access at checkpoints one and two, therefore the athlete carried all food and

75 sports drink that had been planned for her to consume between the start of the race and
76 checkpoint three. The support team then clarified with the athlete which foods she had
77 consumed when she arrived at checkpoint three and whether any additional foods or fluids
78 provided at the earlier checkpoints had been consumed. Within 24 h of the race finish, the
79 subject was asked to verify her intake, and note any discrepancies against the food record.
80 Any foods that were consumed other than that provided by the support team, as well as any
81 foods that were lost en route, were noted.

82

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

93

94 Total energy (kJ), carbohydrate (g), fat (g), protein (g), dietary fibre (g) and sodium (mg) of
95 all foods and fluids were estimated using FoodWorks Professional Edition, Version 6.0.2539,
96 © 1998-2009 (Xyris Software, Brisbane, Australia). Data analysis was performed by a Sports
97 Dietitian (SM). Food composition data were compiled from Nuttab 95; AusFoods; Australian
98 AusNut and nutritional information from food manufacturers entered into the database. On

99 completion of analysis, data entries were verified against the original records provided by the
100 Sports Dietitian (SM) at the time of collection.

101

102 **Nutrition plan**

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

110

111 In considering the duration and intensity of the event along with the subject's tolerance for
112 food and fluid intake during the race, we suggested a target carbohydrate intake of 40 g per
113 hour (Rodriguez, DiMarco, & Langley, 2009). No specific fluid target was provided to the
114 subject as it is thought that in cool environments, as was expected, performance and physical
115 well-being may not be affected by body water losses amounting to 2% of body weight
116 (Coyle, 2004). It was still emphasised that a 'regular fluid intake' was consumed throughout
117 the event, and that this fluid contain carbohydrate and sodium. Sodium rich fluids and foods
118 were included to achieve a sodium intake of 500-1000 mg per hour (Clark, Tobin, & Ellis,
119 1992).

120

121

122

123 **Implementation and outcome of the plan**

124 A pre-race breakfast meal comprising rice porridge, sports drink and coffee was consumed
125 two hours before the race, with additional fluids (cola drink) consumed ~30 min before the
126 race start (Figure 1). The pre-race meal provided ~1000 kJ, 57 g carbohydrate (1.1 g/kg), 750
127 mg sodium, 850ml fluid and ~82 mg caffeine (1.7 mg/kg). The carbohydrate content of the
128 pre-event meal could be considered relatively low compared to current guidelines (Burke et
129 al., 2001). However, due to the opportunities to consume food and fluid throughout the race,
130 it was felt that familiarity and the subject's gastrointestinal comfort with foods and fluids
131 were the priority. Additionally, the subject had undertaken a 'modified' carbohydrate loading
132 program, and consumed a carbohydrate-rich meal the night before the event. At the subject's
133 request, caffeinated beverages were made available pre-race and at checkpoints as an
134 alternative to other carbohydrate containing fluids. The inclusion of caffeine was not as a
135 performance enhancing aid but rather a familiar training beverage choice. The use of
136 concentrated caffeine supplements were not incorporated into the race-day nutrition plan as
137 the subject did not feel comfortable introducing these products during the final stages of
138 training for the race.

139

140 Total food and fluid intake during the race provided 10 890 kJ (736 kJ/h), 558 g carbohydrate
141 (44 g/h), 6150 ml (415 ml/h) fluid and 7403 mg (500 mg/h; 52 mmol/L) sodium (Figure 1).
142 The subject did not complain of any gastric discomfort throughout the event, suggesting that
143 foods and fluids consumed during the event were well tolerated. Overall, hourly carbohydrate
144 intake was slightly above the set target of 40 g/h and similar to that reported in an earlier
145 account of male athletes (42.8 g/h) contesting a 24-h foot-race (Fallon et al., 1998). Of
146 interest, the subject in our case study consumed 34 g/h during the first half of the race,
147 compared with 53 g/h during the second half. The difference in carbohydrate intake

148 throughout the event was likely due to the subject's appetite being satisfied during the early
149 stages of the event following the pre-race meal. Although the pre-race meal only provided 1.1
150 g/kg, this is similar to that previously observed in male subjects competing in a long-distance
151 road cycling event who consumed 1.0 g/kg (Havemann & Goedecke, 2008). In addition, it is
152 probable that limited access to *individualised* food and fluid choices at checkpoints one and
153 two further contributed to the lower carbohydrate intake early in the race.

154

155 Insert Figure 1.

156

157 Sweet (Gatorade Endurance) and savoury (stock) high sodium (84 mg/100 ml and 240
158 mg/100 ml, respectively) fluids were made available to provide a reliable source of sodium,
159 drive thirst and provide varied taste options. The majority of fluid consumed during the race
160 was carried by the subject in a camel pack, and was refilled at each accessible checkpoint.
161 Her intake of sports drink (Gatorade Endurance) remained consistent throughout the race
162 although, as the race progressed, the subject requested it be diluted as the sweetness was
163 becoming less tolerated. In the early stages of the race, the concentration of sports drink was
164 ~5 per cent, but decreased to ~3.5 per cent at the last checkpoint. A total of 3850 ml of
165 Gatorade Endurance was consumed, providing 2835 kJ, 189 g carbohydrate and 2700 mg
166 sodium. This contributed 26% of total energy intake, 34% of total carbohydrate intake, 37%
167 and 63% of sodium and fluid intake, respectively. Cola made up a further 14% of total fluid
168 intake (850 ml) and 16% of total carbohydrate intake (91 g). The consumed volume of cola
169 also provided ~83 mg of caffeine throughout the race. The 'stock' (a stock cube dissolved in
170 warm water) contributed 20% of the total fluid consumed and provided the greatest amount
171 of sodium (3000 mg; 41% of total sodium intake) during the race. Together, these three fluids
172 provided 50% of the subject's overall carbohydrate (280 g), 78% of sodium (5796 mg) and

173 97% of total fluid (5950ml) intake. Of note, the subject did not request water at any stage
174 during the event.

175

176 As previously mentioned, a range of solid snack foods were available to the subject
177 throughout the race. Choices offered were based on the subject's regular training foods as
178 well as others suggested by the sports nutrition team. Sweet foods (such as snack bars,
179 confectionary, PowerBar Gel Blasts) were consumed more frequently during the early stages
180 of the race, with savoury/salty choices becoming more popular as the race progressed (Figure
181 1). Despite the subject relying on confectionary regularly during longer training sessions,
182 they were not well tolerated during the race (Figure 1). The subject had preconceived ideas
183 about the types of foods she would 'crave', and maintained that she would exclusively
184 consume sweet foods. As illustrated in Figure 1. the subject had a wide range of food
185 flavours, including several savoury fluid and food choices. These options were suggested by
186 the sport nutrition team to avoid the issue of 'flavour fatigue', which may arise when only
187 consuming sweet tasting foods and fluids (O'Connor & Cox, 2002).

188

189 Sodium intake increased in the latter part of the race, due mainly to the intake of the 'stock'
190 solution. Although the subject had not trialled the 'stock' in training, she requested this at
191 checkpoints three, four and five (Figure 1). As the race progressed, she preferred the savoury
192 flavour of the 'stock' compared to the sweet tasting fluids. Although the aetiology of muscle
193 cramps remains unclear, the perception that sodium intake would help resolve cramps also
194 drove the subject to consume salty food and fluids after she complained of calf cramps in the
195 early part of the race. The wide selection of high sodium fluids and foods provided adequate
196 sodium (52 mmol/L) to meet current sodium intake guidelines (30-50 mmol/L) suggested for
197 ultraendurance events (Rehrer, 2001).

198 **Reflections**

199 The sports nutrition team played a key role in influencing the variety of foods and fluids
200 offered at checkpoints throughout the race. Despite the subject intending to rely entirely on
201 sweet tasting foods and fluids, savoury options contributed significantly to the overall intake
202 of carbohydrate, sodium and fluid. Before the race, the support team educated the subject on
203 fuelling for performance. Additionally, verbal encouragement was given to increase the
204 amount of food and fluid consumed at each checkpoint, as well as the provision of extra
205 foods in addition to what the subject chose for each leg of the race. The subject responded
206 well to encouragement when it was related to how it could improve performance, and as the
207 race progressed, the subject was more responsive to our suggestions. It is likely the subject
208 would have failed to meet hourly carbohydrate and sodium intake goals had it not been for
209 the variety of foods and fluids provided and the encouragement offered by the sports nutrition
210 team.

211

212 The organisation of provisions at checkpoints, particularly the labelling of food and fluids,
213 allowed the subject to easily identify her choices. The labelling system provided a simple
214 way to approximate carbohydrate intake for both the subject and the support team, as well as
215 indicate when ‘high salt’ options were consumed, which allowed for continual modification
216 of the nutrition plan. It also provided a timely reminder of important nutrients that needed to
217 be consumed. The subject’s ability to select from a wide range of flavours throughout the
218 race allowed her to maintain a consistent carbohydrate and fluid intake, which was important
219 in determining her eventual success.

220

221 Solids and liquids were equally important in providing a source of carbohydrate during this
222 event. This is an interesting observation, as in shorter endurance events athletes have been

223 shown to reduce carbohydrate intake from fluids in cooler race conditions (Cox, Snow, &
224 Burke, 2010). Therefore, in devising a nutritional plan for ultraendurance athletes, it is
225 important to ensure that hourly carbohydrate intake guidelines can be achieved with a varied
226 hourly fluid intake.

227

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

234

235 Nutritional support during an ultraendurance foot race requires the athlete to become familiar
236 with race-day food and fluid choices during daily training. Although we had limited time for
237 nutrition consultation, the success of our planning was partly achieved by incorporating the
238 athlete's food and fluid preferences, within the selection of choices available. Furthermore,
239 careful planning of race-day provisions based on set guidelines is important, however
240 sufficient flexibility should be allowed so the athlete can modify the plan according to their
241 tolerance and opportunities for food and fluid intake, as well as the environmental conditions
242 on race-day.

243

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246 like to thank the support crew who willingly assisted with data collection and the provision of
247 foods and fluids on race-day.

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