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Case report

Applied Sports Nutrition Support, Dietary Intake and Body Composition Changes of a Female Athlete Completing 26 Marathons in 26 Days: A Case Study

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Abstract
The aim of this case study is to describe the nutrition practices of a female recreational runner (VO_2max 48.9 ml·kg^{-1}·min^{-1}) who completed 26 marathons (42.195 km) in 26 consecutive days. Information relating to the nutritional intake of female runners during multi-day endurance events is extremely limited, yet the number of people participating year-on-year continues to increase. This case study reports the nutrition intervention, dietary intake, body composition changes and performance in the lead-up and during the 26 days. Prior to undertaking the 26 marathon challenge, three consultations were held between the athlete and a sports nutrition advisor; planning and tailoring the general diet and race-specific strategies to the endurance challenge. During the marathons, the mean energy and fluid intake was 1039.7 ± 207.9 kcal (607.1 – 1453.2) and 2.39 ± 0.35 L (1.98 – 3.19). Mean hourly carbohydrate intake was 38.9 g·hr^{-1}. 11 days following the completion of the 26 marathons, body mass had reduced by 4.6 kg and lean body mass increasing by 0.53 kg when compared with 20 days prior. This case study highlights the importance of providing general and event-specific nutrition education when training for such an event. This is particularly prudent for multi-day endurance running events.

Key words: Athletes, body composition, carbohydrates, diet, running, sports nutritional sciences.

Introduction

Multi-day endurance running (MDER) events are becoming increasingly prevalent among recreational and elite runners (Khodaee and Ansari, 2012; Moran et al., 2011). It is well accepted that adhering to optimal nutritional strategies to meet the physical and environmental conditionals of MDER events is complex (Moran et al., 2011). Furthermore, fatigue is attributed to a multifaceted phenomenon during MDER events, often a combination of dehydration, hyperthermia, carbohydrate depletion, central fatigue and hypoglycaemia (Pfeiffer et al., 2012). Athletes undertaking endurance events are also particularly susceptible to injuries and illnesses.

Athletes and supporting practitioners must appreciate the unique environment, training demands and nutritional preparation required to successfully complete a MDER event. Despite numerous studies reporting food and fluid intake for male athletes during MDER events, to the authors' knowledge, no studies have presented dietary data for female athletes undertaking these types of events. By providing analysis of the interventions provided and an outline of the dietary intake of a recreational female athlete, it will inform future athletes and support staff alike, assisting in identifying and setting individual nutrition strategies for MDER events.

In accordance with the Declaration of Helsinki and University of Essex, ethical requirements, informed consent, along with a Physical Activity Readiness Questionnaire (PAR-Q) was obtained from the athlete prior to undertaking physiological testing. The athlete has also provided consent for the publication of the case study.

Case report

History

In October 2012, the athlete approached the Human Performance Unit (HPU), seeking support in the lead up to and during (August, 2013) the undertaking of 26 marathons in 26 consecutive days. The individual was a 38 year old female (VO_2max 48.9 ml·kg^{-1}·min^{-1}; body mass 65.0 kg; height 1.65 m; BMI 23.7 kg·m^{-2}). She had little previous experience of endurance running, and was completing the event as a piece of performance art rather than purely as an athletic challenge.

MDER event information

The challenge undertaken was a solo event, in which the same 1-mile course (Edinburgh 'Royal Mile', Scotland, 55.9506° N, 3.1856° W) was repeatedly traversed each day. The course presented an ascent/descent of 58.7 meters dependent on direction (max 7% gradient). Furthermore, the 26 days coincided with the Edinburgh Fringe Festival when large numbers of pedestrians would present physical obstacles to the course being traversed. The athlete began each marathon at 7:00 am. The ambient temperature varied from 7°C - 23°C throughout the 26 days. One person assisted with data collection, food provision and general logistics each day positioned at the mid-point along the 'Royal Mile'; where the athlete would pass every mile.

Needs analysis

A needs analysis was undertaken, starting with evidence gathering, drawing upon published literature, to facilitate the creation of a client specific action plan. The subsequent phase involved measurement of the athlete's physiology, anthropometry and a dietary assessment. The physiological demands (Laursen and Rhodes, 2001), training principles (Zaryski and Smith, 2005), nutritional demands (Getzin et al., 2011; Knechtle, 2013; O'Brien et al., 1993;

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Pfeiffer et al., 2012) and risk/management of injuries (Khodaee and Ansari., 2012; Krabak et al., 2011; 2013) of undertaking a marathon and/or ultra-endurance events have been well documented.

Areas of scientific support provided included; periodised training advice (Laursen and Rhodes, 2001), and sports psychology support to aid with athlete mental coping strategies (Zaryski and Smith, 2005). Dietary considerations included; (1) nutrition strategies to support training, (2) before, during and post exercise strategies (Peters, 2003; Burke et al., 2011), (3) strategies to support optimal immune function (Gleeson et al, 2004) and (4) building a food plan for during the event taking account of the athlete's food preferences (Burke, 2002; Clark et al, 1992).

Case formulation and intervention selection

It was agreed that support provision would focus on three primary areas; (1) food and fluid strategies to optimise training, recovery and event specific requirements, (2) physiological testing, training advice and monitoring and (3) sports psychology support. For the purpose of this article, the focus will be on the sports nutrition intervention and dietary intake during the event, coupled with anthropometric measures. Figure 1 provides an overview of the sessions with the athlete over the 12 months.

Prior to the first nutrition consultation in March 2013; a structured plan was presented to the athlete, outlining the key dietary topics in the build-up to the MDER event. A progressive nutrition plan was proposed to develop the athlete's nutrition knowledge, empowering the athlete to make decisions based upon the daily training load, timing, duration and intensity of individual sessions, urgency to recover / replenish depleted substrates and supporting optimal health (Figure 1).

Following the initial nutrition consultation, the athlete was provided a detailed report, with a focus on providing evidence-based recommendations, supported by practical food examples. The athlete also received: (a) a 'food example' document, highlighting good, moderate and poor food choices, and (b) a 3-day meal plan example detailing optimal portion sizes, with the athlete being asked to weigh their food to ensure adherence to the recommended serving sizes. Based upon the athlete's training load at that time (typically 90 minutes of running per day, ~6 times per week) and body composition data (height, weight), estimated energy expenditure was calculated using the average of three age and gender specific RMR equations (Harris and Benedict, 1919; Mifflin et al., 1990; Owen et al., 1986) and multiplied by known physical activity levels (Brooks et al., 2004). This data was used to formulate the 3 day meal plan examples and inform the athlete of calorific requirements for training and rest days.

Strategies to support immune function were implemented if reported to have 'modest supporting evidence' or above as indicated by Walsh et al. (2013). These include a carbohydrate intake of 30-60 g per hour during exercise, vitamin D supplementation (Ultra Vitamin D, Vitabiotics, UK) in light of time of year and local latitude (1000 UI·d^{-1}, unless exposed to direct sunlight for >30 min) (Halliday et al., 2011; Larson-Meyer and Willis, 2010), and daily probiotic supplementation of Lactobacillus casei Shirota (Yakult, UK) (Gleeson et al., 2011).

During the second nutrition consultation the athlete was provided with a list of high carbohydrate drinks, sweets and light snacks to trial during training, with an emphasis on the need to prevent 'flavour fatigue' and an associated decrease in energy intake (Burke, 2002). Savory/salty options were provided to stimulate the athletes desire to eat. By providing this information 4 months, it enabled time for the athlete to identify what could be tolerated during exercise. High-fibre foods were limited from the list to reduce the risk of gastro-intestinal distress (Maughan. 2006).

Fluid consumption recommendations during exercise were established based upon athlete feedback and pre- and post-weighing around event pace training runs. Furthermore, a detailed 'fluid intake and sweat loss'

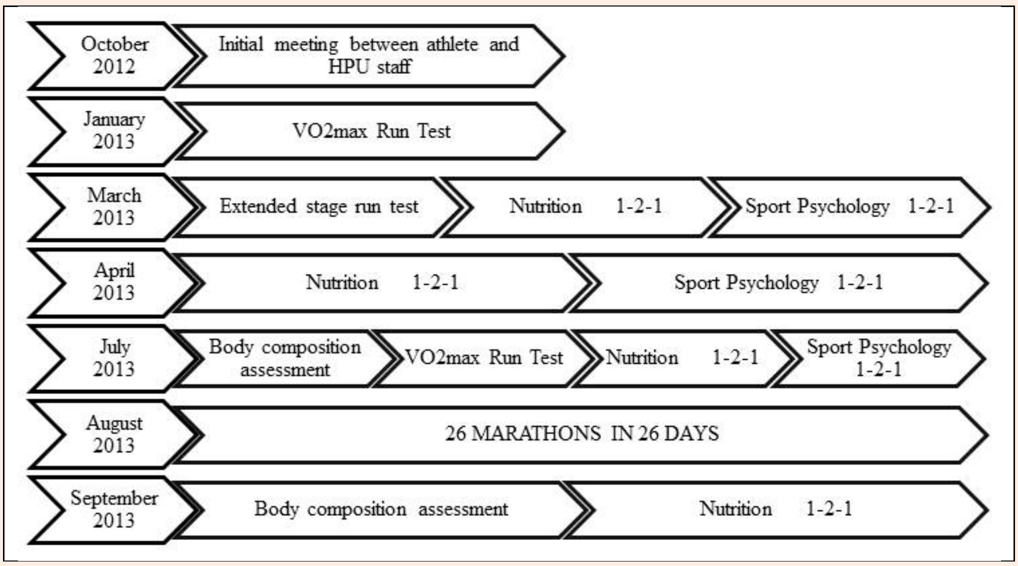

Figure 1. A chronological overview of the support provided by staff prior too, during and following the MDER event.

Table 1. Mean macronutrient and fluid intake during 26 marathons and pre-event 'target values'.

	Target Values	Mean (Range) Intake	Mean Relative Intake*
Pre Marathon CHO intake (g)	1 - 4 g/kg/BM [1]	**155.17** (144.52-156.9)	2.6 g/kg/BM
Pre Marathon Fluid intake (ml)	5 - 7 ml/kg/BM [1]	**500.00** (500.00 - 500.00)	8.3 ml/kg/BM
During Marathon CHO intake (g/hr)	30 - 60 g/hr [1]	**38.87** (20.73-65.26)	---
During Marathon Fluid intake (ml)	---	**2390.35** (1984-3193)	39.5 ml/kg/BM
Post Marathon CHO intake (g)	1.0 - 1.5 g/kg/BM within 30 minutes [1]	**76.34** (30.00 - 154.6)	1.3 g/kg/BM
Total Daily CHO Intake (g)	6 - 10 g/kg/BM/d [1]	**595.11** (439.15-712.97)	9.8 g/kg/BM
Total Daily Protein Intake (g)	1.2 - 1.4 g/kg/BM/d [1]	**171.02** (143.1-200.81)	2.8 g/kg/BM
Total Daily Fat Intake (g)	>1g/kg/BM/d [2]	**81.97** (42.76-123)	1.35 g/kg/BM

[1] Guidelines extracted from 'Rodriguez et al., (2009)'. [2] Guidelines extracted from 'Rosenbloom (2012)'. * Relative values based upon Day 1 body mass (60.5 kg).

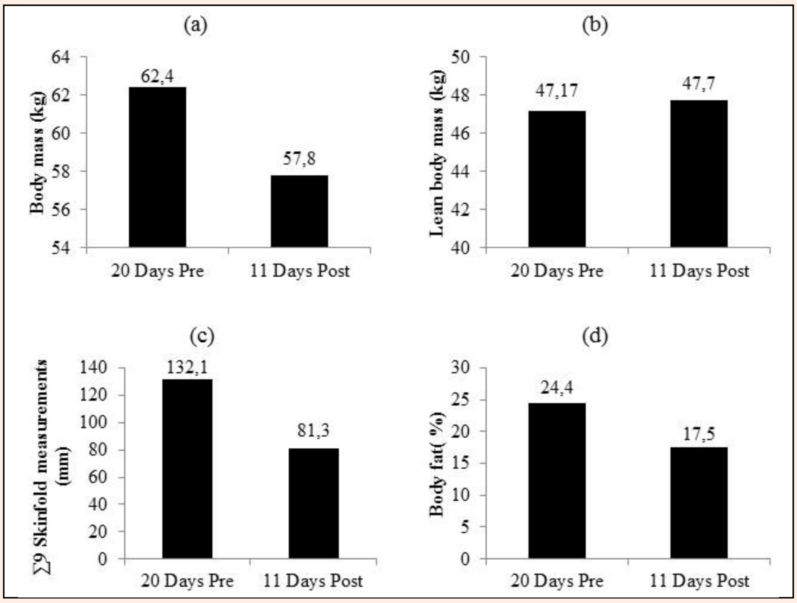

Figure 2. Anthropometrical changes observed between pre and post completion of 26 marathons.

monitoring session was undertaken approximately 1 month prior to the start of the event when the athlete undertook 2 marathons on consecutive days. Data obtained during these two days provided the athlete's voluntary fluid intake, carbohydrate intake, pacing, heart rate and identification of any food or fluid deficits.

The third nutrition session focused on event specific dietary challenges, such as meal timing, food accessibility and logistical concerns. Target carbohydrate, protein and fat values were established based upon both ACSM guidelines and additional studies involving ultra-endurance running and female athletes (Rosenbloom and Coleman, 2012). Target values are shown in Table 1. It was identified that achieving target macronutrient values, coupled with maximising the athletes sleep duration and minimising gastro-intestinal distress, would require the use of additional supplements. A carbohydrate-protein (CHO-PRO) drink was recommended at breakfast (Oats and Whey, Optimum Nutrition, Glanbia Plc, Ireland), along with cereal and fruit. For post-exercise, a high calorie CHO-PRO drink (Pro Complex Gainer, Optimum Nutrition, Glanbia Plc, Ireland) was also advised. These supplements were introduced into the athlete's training routine four weeks prior to beginning the 26 marathons to ensure palatability and practice the consumption of race-day breakfast and recovery strategies.

During the event a heart rate (HR) monitor, coupled with GPS and stride rate using a telemetric receiver and foot pod was worn (910XT, Garmin Ltd., Schaffhausen, Switzerland). The athlete manually started the stopwatch/HR monitor upon the commencement of each marathon and stopped once 26.2 miles had been achieved. Dietary intake during each marathon was recorded by the support crew positioned mid-way along the 1 mile route. Pre-packaged carbohydrate snacks of 10 g were made available. Prior to, and following each marathon, the athlete self-reported dietary intake on a daily basis. All food and fluid consumed was immediately recorded, including brand names, known weights and measures if available, portion descriptions and nutritional information if provided on packaging. Dietary analysis was performed by trained staff using 'WinDiets Nutritional Analysis Software Suite' (version 1.0; The Robert Gordon University, Aberdeen, United Kingdom). Body composition assessments were undertaken by an ISAK (International Society for the Advancement of Kinanthropometry) accredited individual. The same individual undertook all body composition assessments to minimise inter-tester variation. The athlete's anthropometric profile consisted of height (Leicester height measure, Seca, Birmingham, UK), body mass (SECA Scale 813, Hamburg, German), breadths, girths and nine site skinfold measures

(Harpenden Calipers, Baty International, West Sussex, UK). The LifeSize Educational Software for Body Composition Analysis program (Human Kinetics Software, Champaign IL, USA) was used to estimate body shape, size, and composition including percent body fat.

Evaluation of intervention

During the 26 days telephone and email contact with the athlete was maintained enabling the athlete to report any dietary issues. A breakdown of macronutrient and fluid intake (Table 1), and anthropometrical data (Figure 2) across the 26 marathons are shown. Daily food intake for the total 26 days provided 99,570 kcal and 112.9 L of fluid. Carbohydrate (CHO) intake contributed 62.6% energy intake whilst protein (PRO) and fat provided 17.9 and 19.4% respectively. During the marathons, the mean energy and fluid intake was 1039.7 ± 207.9 kcal (607.1 – 1453.2) and 2.39 ± 0.35 L (1.98 – 3.19). CHO provided the majority of energy over the course of all 26 marathons (CHO = 92.8%; PRO = 2.8%; FAT = 4.3%) and mean hourly reported carbohydrate intake was 38.9 g/hr. During the 26 days, the athlete reported no symptoms suggestive of a suppressed immune function i.e. sore throat, fever.

Total distance completed was 1097.07 km in a total time of 165 h 30 min 01 s. Mean marathon time was 6 h 21 min 55 s (5:09:14 – 7:30:00) with both moving and total time slowing throughout the 26 days.

Anthropometrical assessments performed 19 days prior and 11 days post the 26 marathons report a reduction in body mass of 4.6 kg (62.4 – 57.8), the sum of 9 skinfold measures decreasing from 132.1 to 81.3 mm and percent body fat reducing from 24.4% to 17.5%. During the 26 marathon days, body mass increased by 1.1 kg (60.5 – 61.6), which might be explained by exercise induced hypervolemia.

Discussion

Upon successful completion, the client stated, "the sports science interventions that we agreed have seen me cope with the physical and mental challenges of this endurance performance as well as my ability to recover". Despite the athlete's positive feedback, lessons can always be learnt from unique challenges, whether successful or not. In this instance, whilst the goal was achieved and the athletes health was not compromised, possible alterations to the sport science delivery could have provided a greater scientific insight for applied perspectives. One such limitation was the period of time between pre and post body composition assessments. By undertaking body composition assessments on day 1 and 26 would have provided a more detailed insight into acute anthropometrical changes, followed by repeated measures post event to monitor the recovery from hypervolemia induced changes. The nutritional strategies implemented in the initial stage were largely based upon current literature and 'target values', thus relatively straightforward to establish. However, the athlete reported GI discomfort following breakfast after the initial few days, stating that the amount expected to consume was causing discomfort and feelings of nausea. Whilst a serious concern for many athletes, the regular communication with the athlete enabled small changes to the timing of breakfast, extending the duration and spreading the intake of fluid across a longer period, helping the athlete to maintain the target breakfast, without severely reducing calorific intake.

The results of this case study demonstrate that by adhering to current nutrition guidelines generally centered on single bout endurance sports (i.e. marathon running), provide important targets that in this instance where sufficient to contribute towards a female runner completing 26 marathons in 26 consecutive days. The athlete in this case study was predominantly achieving values close to the upper range for many recommended values (CHO pre event, during, post); however, daily protein intake was significantly above that of recommended values. The additional protein consumed contributed towards the athletes total energy intake achieving an energy balance and attenuating lean body mass reductions. It is unsurprising that the large quantity of daily protein consumed was largely due to the supplements within the daily diet, however, it is speculated that without these, the athlete would have struggled to consume the equivalent energy as whole foods.

Conclusion

The current case study highlights the importance of providing both general and event specific nutrition education in the months prior to undertaking multi-day endurance events. Furthermore, communication during the event between athlete and practitioner provides a forum in which reflections can be discussed and modifications to the diet made if required.

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Key points

- Multi-day endurance running (MDER) events are increasingly prevalent among recreational and elite runners, as such, reporting the practices of populations underrepresented in the literature are important.
- This case study reports nutritional practices of a female recreational runner undertaking 26 marathons in 26 consecutive days.
- This case study highlights the importance of providing general and event-specific nutrition education when training for such an event. This is particularly prudent for MDER events.

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