Rowan University
Master of Nutrition & Dietetics
NUT00500

Nutritional Considerations for Endurance Athletes

Hannah Holshue

Words: 1270

Marathon running, as stated by Janice Dada, RD, CSSD, is "a feat of strength, endurance, and stamina, and proper hydration, nutrition, and training are vital to a runner's success and survival" (1). While all forms of aerobic training disrupt homeostasis, running across long distances (as in a standard 26.2-mile marathon) presents unique challenges. Long-distance aerobic activities subject organ systems such as the cardiovascular, pulmonary, and muscular systems to stress for prolonged durations of time. An athlete is placed under immense physical and mental strain in the weeks leading up to a marathon as well as during the actual event. Novice runners commonly log 40 miles a week in preparation for marathon events, training consistently for nearly 20 weeks prior to a race (1). Such rigorous training taxes an athlete's body by placing increased demands on physiological and bioenergetic pathways. Proper hydration and sports-specific nutritional strategies must therefore be implemented to ensure an athlete is capable of successfully and healthily completing their race. I propose that marathon/ultramarathon runners require special nutritional consideration from sports nutrition professionals as general recommendations for energy (specifically carbohydrate) intakes may not be adequate to meet the demands of marathon training and completion.

Carbohydrates should be emphasized when making nutritional recommendations for an endurance athlete. Generally speaking, the Dietary Reference Intakes (DRIs) for adults recommend a diet comprised mostly of carbohydrates (2). The Acceptable Macronutrient Distribution Ranges for energy percentages suggest that an adult diet consist of 45-65 percent carbohydrates, 25-35 percent fats, and 10-35 percent protein (2). Athletes should aim to adhere to these general recommendations by falling within these ranges for a given macronutrient. However, high-level athletes are quite different from the general population on which the AMDR is based. Aerobic athletes (especially endurance athletes such as marathon/ultramarathon

runners) have greater carbohydrate needs (3). Hence, athletes should aim for the higher end of the AMDR range on a day-to-day basis.

Adequate carbohydrate consumption is critical from a performance standpoint. When an athlete engages in activity that exceeds 70 percent of their VO_2max, serum glucose becomes the main energy source (3). Having adequate levels of serum glucose is dependent upon the pre-race/training meal and the athlete's stored glycogen (3). When muscle glycogen levels are depleted during a run, the muscle will experience fatigue and a consequent decrease in performance (3). It is therefore recommended that an aerobic endurance athlete consume adequate carbohydrate in their overall diet to promote advantageous muscle glycogen stores (3). Moreover, glycogen has the added benefit of storing water, which can be beneficial in maintaining "homeostatic core body temperature via thermoregulatory and/or cooling strategies" (3).

Carbohydrate intakes should adjust as marathon training progresses (4). Increases in training volume and intensity warrant increased carbohydrate consumption. As sessions grow in duration, an athlete will necessitate greater carbohydrate to support sustained activity; this is due to the aforementioned bioenergetics of energy production, which rely on serum and stored glycogen levels (5). The scientific literature supports daily carbohydrate intakes of 7-12 grams per kilogram of bodyweight, with intakes of 1-4 grams per kilogram of bodyweight during the 4-hour pre-race period (5).

Intra-race nutrition presents an opportunity for athletes to boost performance. Most importantly, nutrition during an intense running session ensures an athlete will maintain proper hydration. While hydration plays a substantial role in achieving peak performance, failure to properly hydrate can be fatal (5). When physical activity must be sustained in hot environments,

athletes are advised to ingest “a sports drink containing 20 to 30 mEq of sodium (460-690 mg with chloride as the anion) per liter, 2 to 5 mEq of potassium (78-195 mg) per liter, and carbohydrate in a concentration of 5% to 10%” (4). It is noteworthy to educate athletes about the importance of replenishing these electrolytes as consumption of pure water increases the risk of hyponatremia (3). As stated by Dada, “Hydration during a marathon is a delicate balance of fluid, carbohydrate, and electrolyte consumption” (1). A general guideline supported by the literature is to “consume enough fluid…to prevent water weight losses exceeding 2% of body weight” (4).

The addition of carbohydrates intra-race promotes peak performance. When carbohydrate is included with hydration measures, runners may experience increases in aerobic capacity via improved nervous system signaling (5). This effect has been observed when runners employ simple “mouth rinsing” techniques during the first 45 minutes of a run (5). During prolonged events such as marathon races, it is recommended that athletes consume 75-90 grams of carbohydrate per hour in multiple-transportable form (5). The inclusion of multiple sources of carbohydrate (namely glucose, sucrose, fructose, and maltodextrin) promotes advantageous absorption by preventing limited oxidation when one intestinal transporter becomes fully saturated (4). By strategically consuming simple sugars during competition, serum glucose is readily available for the muscles to fuel activity, minimizing fatigue that may impair performance.

Finally, it is critical that sufficient carbohydrate, fluid and electrolytes be taken in to restore considerable water losses and depleted muscle and liver glycogen. It is recommended that aerobic endurance athletes consume simple, fast-acting carbohydrates immediately post-exercise (1). A 3:1 ratio of carbohydrate and protein is suggested to promote glycogen resynthesis and aid

in muscle tissue repair (1). Consuming a carbohydrate-rich meal with approximately 1.0-1.2 grams per kilogram of bodyweight has been suggested in the scientific literature (3). Additionally, the inclusion of protein may aid in the prevention of muscle soreness and should total 10 grams minimum within 3 hours of activity (3). Generally speaking, an aerobic athlete should aim to consume 1.2 to 1.4 grams of protein per kilogram of body weight per day to offset exercise-induced muscle damages that result from routine training and competition (1).

To conclude, marathon/ultramarathon runners and aerobic endurance athletes are of a special population that necessitates special nutritional considerations. Marathon running, as well as the physical training leading up to competition, places an athlete's body under a tremendous amount of stress. Increased energy requirements of prolonged activity warrant higher-than-average carbohydrate intakes. Athletes should consume a diet that parallels DRI recommendations with percentages of macronutrients falling within the general AMDR; However, it is advantageous for athletes to deviate from these recommendations within reason. From a practical standpoint, an athlete may perform at a higher level if consuming the higher end of the carbohydrate range (65 percent or greater) while ensuring they are consuming sufficient protein to repair damaged muscle tissue. Fat should be consumed in lower quantities, but comprise a minimum of 10 percent of total energy intake to prevent malabsorption of fat-soluble vitamins A, D, E, and K. Increased attention must be given to an athlete's hydration status to avoid serious health complications (i.e. heat stroke, hyponatremia) and prevent dehydration-related declines in performance.

Sports-specific nutrition is highly individualized and complex. Failure to meet an athlete's increased nutrient needs could pose an assortment of negative health effects. As asserted by Costa and colleagues: "Excessive transient or long-term low-grade energy (and

nutritional) deficits justify considering ultramarathon runners as a high-risk population for the development of relative energy deficiency syndrome (including the female triad), unexplained underperformance (overtraining) syndrome, exercise-induced gastrointestinal syndrome, soft tissue injuries and illnesses/infections, with associated acute and chronic health implications of clinical significance" (3). Physiological demands of prolonged running can subject an athlete to serious health consequences (even fatalities) if not addressed appropriately. Therefore, as a final recommendation I advise any novice marathon runner or endurance athlete to consult a Registered Dietitian with expertise in the concentration of sports nutrition prior to beginning any intense training regimen. Just as an athlete must engage in sports-specific training, nutrition must be strategized to meet aforementioned nutritional demands and ensure the health and success of the athlete.

References

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