Nutrition for Throwers, Jumpers and Combined Events Athletes

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Abstract
Throwers, jumpers and combined events athletes require speed, strength, power and a wide variety of technical skills to be successful in their events. There are only a small number of studies assessing the nutritional needs of these athletes. Due to these limitations, recommendations for nutritional requirements to support and enhance training and competition performances for these athletes are made using research findings from sports and exercise protocols similar to their training and competitive events. Goals of the preparation cycle of nutrition periodization for these athletes include attaining desirable body weight and a high ratio of lean body mass to body height and improving muscular power. Nutritional recommendations for training and competition periods include: 1) meeting energy needs; 2) timing consumption of adequate fluid and electrolyte intakes before, during and after exercise to promote adequate hydration; 3) timing consumption of carbohydrate intake to provide adequate fuel for energy demands and to spare protein for muscle repair, growth and maintenance; 4) timing consumption of adequate protein intake to meet protein synthesis and turnover needs; and 5) consuming effective nutritional and dietary supplements. Translating these nutrient and dietary recommendations into guidelines these athletes can apply during training and competition is important for enhancing performance.
There have been a small number of studies assessing the nutritional needs, dietary intake and body composition of elite athletes in throwing, jumping and combined events (Faber, Spinnler-Benade and Daubitzer 1990; Houtkooper, Mullins, Going, Brown, and Lohman 2001; Mullins, Houtkooper, Howell, Going and Brown, 2001; Malina 1992). Due to this limitation, recommendations for nutritional needs for training and competition are made using research findings from athletes that have exercise training and competition schedules similar to these athletes.

Combined events athletes participate in the men’s decathlon (heptathlon in indoor competition) and women’s heptathlon (pentathlon in indoor competition); these competitions consist primarily of events requiring speed, endurance, strength, power and a wide variety of technical skills. The decathlon includes ten events which take place over two consecutive days: 100m, long jump, shot put, high jump, 400m, 110m hurdles, discus, pole vault, javelin and 1500m. The heptathlon includes seven events over two days: 100m hurdles, shot put, high jump, 200m, long jump, javelin and 800m (International Association of Athletics Federations 2007).

Throwing events include the shot put, discus, javelin and hammer which require strength, power, speed and technical skills. Successful shot putters have a large body mass, strong arms and legs. They must produce the dynamic power needed to propel a heavy, metal ball as far as possible. The discus thrower must add a wide reach, speed on the turn and a sense of rhythm to the shot putter’s skills. The javelin weighs less than the other throwing implements and requires a fast run-up, smooth acceleration and power for a fast throw. Hammer throwers require both a relatively large body mass and throwing technique that includes strength, speed, and relaxation (International Association of Athletics Federations 2007).

Jumps include high jump, long jump, triple jump, and pole vault. The high jump requires strength, power, speed, coordination and relaxation. A long jumper transforms running movement into flight by using powerful legs and an elastic take-off. The triple jumper requires a precise approach, producing kinetic energy from an almost maximum approach speed.. The pole vault requires strong arms and shoulders, a high jumper’s skills of relaxation and coordination, a sprinter’s speed and a gymnast’s control (International Association of Athletics Federations 2007).

Nutrition for Training Periodization

The principles related to training periodization, separating training into different cycles by varying specificity, intensity and volume, can be applied to nutrient and dietary intake (Seebohar, 2004; Stellingwerff, Boit and Res, 2007). Nutritional needs vary with the periods of training: preparation, competition, off-season and the transitions between these periods.

Several nutritional factors are required for these athletes to achieve their training and performance goals, including: 1) meeting energy needs, 2) timing consumption of adequate fluid and electrolyte intakes before, during and after exercise to promote adequate hydration (Coyle, 2004; American College of Sports Medicine et al. 2007; Ganio, Casa, Armstrong and Maresh, 2007); 3) timing consumption of carbohydrate intake to provide
adequate fuel for energy demands and to spare protein for muscle repair, growth and maintenance (Tipton and Witard, 2007; Burke, Kiens and Ivy, 2004); 4) timing consumption of adequate protein intake to meet protein synthesis and turnover needs (Rasmussen, Tipton, Miller, Wolf and Wolfe, 2000; Miller, Tipton, Chinkes, Wolf and Wolfe, 2003; Tipton and Wolfe, 2004; Tipton and Witard, 2007), and 5) choosing effective nutritional and dietary supplements (Volpe 2007; Maughan, King and Lea, 2004, Maughan, Depiesse and Geyer, 2007).

**Energy.** In the preparation cycle of the training period athletes should strive to attain their competitive body weight and composition (e.g., gain muscle mass and/or lose body fat) and to improve or maintain muscular strength and power. Table 1. summarizes body composition profiles for throwers, jumpers and combined events athletes. The relationships among body weight, body composition, power-to-mass ratio and performance in different athletic events and strategies used to reduce weight and body fat have been addressed by O’Connor, Olds and Maughan (2007) and Tipton et al. (2007). Issues related to low energy availability and body composition are addressed by Manore, Kam and Loucks (2007).

Energy needs vary with the training, competition, and transition periods. Carbohydrate is the major energy source. Protein provides energy but it should be consumed in an amount that meets amino acids needs for formation and turnover of body protein, leaving fat to provide the remainder of energy needs. Alcohol provides energy but it is not an essential nutrient. Table 2 summarizes reported average daily macronutrient intakes of throwers, jumpers and combined events athletes.

**Fluid.** Euhydration wards off fatigue and heat-related illnesses associated with dehydration (Gonzalez-Alonso, Mora-Rodriguez, Below and Coyle, 1997; Coyle 2004; Shirreffs, Armstrong and Cheuvront, 2004; Ganio et al., 2007). Body weight changes and urine color can be used to assess hydration status. A 1 kg body fluid loss will require about 1.5 liters of fluid to replace the fluid loss. Generally when an athlete is euhydrated urine color will be pale yellow and when dehydrated will be dark colored (Casa et al., 2000). Excessive intakes of some vitamin supplements can also give urine a dark color.

Drinking adequate amounts of fluids before, during, and after exercise, is essential for promoting recovery and preparing for the next training session. Current guidelines indicate that about 4 hours before exercise athletes should drink about 5-7 ml·kg⁻¹ of body weight. If the athlete does not produce urine or the urine is dark colored or highly concentrated then about 3-5 ml·kg⁻¹ of body weight should also be consumed before exercise (American College of Sports Medicine et al. 2007).

The current guidelines and strategies for fluid intake and replacement are based on the goal of matching intake with loss. Achieving euhydration can be difficult and a goal of limiting fluid loss to <2% body weight reduction may be more feasible and research indicates that it does not adversely affect exercise performance (Casa et al., 2000; Coyle 2004; Shirreffs et al., 2007). Specific guidelines for fluid intake before, during, and after training are discussed by Shirreffs et al. (2007) and have been reviewed previously (Coyle 2004; Shirreffs et al., 2004; American College of Sports Medicine et al. 2007; Ganio et al., 2007).
Moderate (300-400 mg·d⁻¹) acute and long-term caffeine intake does not appear to negatively affect hydration status during exercise (Fiala, Casa and Roti, 2004; Armstrong et al., 2005; Roti et al., 2006). Caution should be practiced regarding caffeine intake since some athletes find the stimulant effect of caffeine causes gastrointestinal discomfort, over stimulation of the nervous system or sleep disturbances.

**Carbohydrate.** Depletion of carbohydrate stores is an underlying factor leading to fatigue and decreased performance (Maughan and Burke, 2002; Hargreaves, Hawley and Jeukendrup, 2004). Daily exercise training recovery fuel needs during very light training with low-intensity exercise or skill-based exercise can be met with 3-5 g of carbohydrate·kg⁻¹·body weight·d⁻¹ (Burke, 2007). Consuming 5-7 g·kg⁻¹·d⁻¹ will support recovery fuel needs for athletes with moderate training programs lasting less than 1 h·d⁻¹ (Balsom, Gaitanos, Soderlund and Ekblom, 1999; Burke et al., 2004; Burke, 2007). Carbohydrate intakes of 7-12 g·kg⁻¹·d⁻¹ will meet daily recovery fuel needs for moderate- to high-intensity exercise training lasting 1 – 3 h·d⁻¹ (Burke et al., 2004).

Timing of carbohydrate intake in relation to exercise training is important. Pre-exercise training meals should generally be consumed 1 - 4 hours prior to starting exercise and contain around 1 – 4 g·kg⁻¹·d⁻¹ of carbohydrate (Hargreaves et al., 2004). Training sessions for jumpers, throwers, and combined events athletes often last 1.5 to >3 hours (continuous or accumulated) and significantly draw upon the athlete’s glycogen stores. If these stores are not replaced during or following exercise, performance in subsequent training sessions can be hindered leading to a reduction in overall performance. Strength-training to increase muscle mass and power-to-mass ratio also requires adequate carbohydrate intake to provide energy to fuel training and help ensure total energy needs are met while sparing protein for muscle growth and turnover (Tipton and Wolfe, 2004).

Athletes need to plan ahead to have carbohydrate readily available during training sessions of moderate-intensity or intermittent exercise that lasts longer than one hour. In general it is recommended for these types of sessions that athletes consume 0.5 – 1.0 g·kg⁻¹·h⁻¹ or about 30 - 60 g·r⁻¹ throughout each hour of actual exercise training period, by eating/drinking every 10-30 minutes (Coyle, 2004; Burke, 2007).

The highest rates of glycogen replacement occur within the first hour post-exercise (Burke et al., 2004) and thus athletes can take advantage of this opportunity by planning recovery meals and snacks that contain adequate carbohydrate. Following exercise, consuming 1.0 - 1.2 g of carbohydrate·kg⁻¹ body weight immediately after and then again 2 hours following exercise (Burke et al., 2004) will help replenish glycogen stores. This enhanced period of glycogen storage is related to exercise-induced glycogen depletion activating glycogen synthase (Wojtaszewski, Nielsen, Kiens and Richter, 2001), exercise-induced increases in insulin sensitivity (Richter and Mikines,1989), and exercise sensitization of muscle cell membranes to glucose delivery (Burke et al., 2004).

Carbohydrate by itself may not be the only macronutrient important for glycogen replenishment. Some research supports that the addition of protein enhances glycogen storage, (Ivy et al., 2002), but such findings have not been supported by all (Tarnopolsky et al., 1997; Carrithers et al., 2000; van Loon, Saris, Kruijshoop, and Wagenmakers, 2000; Jentjens, van...
Loon, Mann, Wagenmakers and Jeukendrup, 2001). Evaluation of study designs between the conflicting groups shows that the timing interval of nutrient consumption and total amount of carbohydrate consumed may explain the disagreement. Studies that provided exercisers with either a carbohydrate-alone or carbohydrate-plus-protein beverage at frequent intervals (i.e. every 15 to 30 minutes) after exercise found no difference in glycogen storage; (Tarnopolsky et al., 1997; Carrithers et al., 2000; van Loon et al., 2000; Jentjens et al., 2001) whereas, studies using feeding intervals of 2 hours did (Zawadzki, Yaspelkis and Ivy, 1992; Ivy et al., 2002). These results suggest that more frequent consumption of carbohydrate may offset any benefit that additional protein can have on enhancing glycogen resynthesis. When consumption of carbohydrate is high (~1.0 g·kg⁻¹ of body weight) additional protein does not appear to provide any further benefit for glycogen resynthesis (Jentjens, et al., 2001).

When recovery time is short between exercise sessions the consumption of a carbohydrate-plus-protein beverage or snack relatively soon after exercise has been shown to improve glycogen recovery over that of a beverage or snack containing only carbohydrate and consumed at the same two time periods (Ivy et al., 2002). Currently, it is not clear if consumption of protein with carbohydrate post-exercise will improve glycogen resynthesis, particularly, for sports with limited recovery time periods, but it is unlikely that the addition of protein to a post-training snack will decrease glycogen resynthesis.

Protein. Protein provides amino acids which play key roles in formation and turnover of protein in the body and also provides energy. Power male athletes doing serious resistance exercise can meet their protein needs in the early phase of training by consuming 1.5 – 1.7 g of protein·kg⁻¹ of body weight · d⁻¹ and in an established training program with 1.0 – 1.2 g·kg⁻¹·d⁻¹ (Lemon, 2000; Tarnopolsky, 2006; Burke, 2007). Highly trained athletes with periods of large and intense training loads who consume a maximum of 1.7 g·kg⁻¹·d⁻¹ will adequately meet their protein needs (Tarnopolsky, 2004). These protein guidelines should also meet the needs of the female athlete too.

Most power athletes have high intakes of protein (Tarnopolsky 2006). Estimates of the protein intake for male throwers are 1.65 g·kg⁻¹·d⁻¹ and 1.14 g·kg⁻¹·d⁻¹ for females (Faber et al., 1990). Dietary estimates of protein intake by female combined events athletes are around 1.4 g·kg⁻¹·d⁻¹ (Mullins et al., 2001). In the off-season and transition periods of training when exercise loads and duration are small, protein needs are lower and similar to the needs for recreational exercisers of 0.8 -1.0 g·kg⁻¹·d⁻¹ (American College of Sports Medicine 2000; Burke, 2007).

Recommending the exact amount of protein needs for individual athletes is controversial. A recent review on the controversy indicates that determining a research-based consensus for the protein needs for athletes is unrealistic because many factors influence their protein needs (Tipton and Wittard, 2007). Two factors are important for making individualized recommendations for protein intake. First, overall energy needs must be met to allow ingested protein to be available for muscle repair, maintenance and growth (Tipton and Wolfe, 2004; Tipton and Wittard, 2007). Second, timing of protein intake is important for influencing the anabolic response of muscle in relation to exercise.
Timing of protein ingestion is particularly important for jumpers, throwers, and combined events athletes during the period of training when they are trying to build strength and power. When muscle hypertrophy and improving power-to-mass ratio are goals the focus should be on consuming enough energy, while consuming protein close to the start and/or cessation of exercise, as well as maintaining adequate protein and energy intakes during rest days (Tipton and Wolfe, 2004). The high protein intakes, common in these athletes, are unlikely to cause harm to their health; however, emphasis should be placed on ensuring that protein consumption does not compromise the consumption of other nutrients, especially carbohydrate, which are also essential for athletic success (Tipton and Wolfe, 2004; Tipton and Witard, 2007).

Protein from food sources readily provides all of the amino acids needed to meet protein requirements (Elliot 2006). Protein supplements may be convenient sources of protein and amino acids; however, they do not provide protein that is superior to protein in food. Additional details regarding protein requirements for increasing size, strength, power-to-body mass ratio are addressed by Tipton et al. (2007).

**Other Nutrient and Dietary Considerations.**

**Vitamins and Minerals.** Research assessing vitamin and mineral intakes of athletes, has been limited because it has been conducted mainly in female populations and only evaluating a few types of sports (Volpe, 2007). A recent review on the topic indicates that dietary calcium is often low in diets of male athletes, while dietary calcium and iron intakes are low in female athletes (Volpe, 2007). The only identified study evaluating the diet of combined events athletes reported that female heptathletes did not consume adequate vitamin E (Mullins et al., 2001). Without adequate research-based information on the vitamin and mineral intakes of jumpers, throwers, and combined events athletes, definitive conclusions about their ability to meet their needs for these nutrients from dietary sources cannot be made.

In general, the Dietary Reference Intakes (DRI) for micronutrients should be met for athletes, as long as the athletes are meeting their energy needs from a variety of recommended foods groups (Volpe, 2007). When athletes' diets are restrictive in total energy, limited in food variety, or severely restrict or eliminate specific food groups (i.e., meat or dairy) low-dose vitamin and mineral supplementation may be warranted to help athletes meet their needs for these nutrients (Maughan et al., 2007). For these athletes, consuming a vitamin and mineral supplement that does not exceed the DRI levels for these nutrients may be appropriate.

The roles some vitamins and minerals play as antioxidants (e.g., vitamin C, vitamin E, beta-carotene, selenium), has received attention because of the high levels of oxidative stress that exercise can induce (Sen, 1995; Clarkson and Thompson, 2000; Sen, 2001; Powers, DeRuisseau, Quindry and Hamilton, 2004; Atalay, Lappalainen, and Sen, 2006). There are limited data indicating that athletes need additional antioxidants in their diet or that dietary antioxidant supplementation will improve performance (Powers et al., 2004). A recent review of dietary antioxidants for athletes made these recommendations: 1) antioxidant needs vary with individuals therefore each athlete’s needs should be assessed before supplementation recommendations can be made and 2) athletes should
be cautious when considering antioxidant supplementation and if deemed necessary choose multi-nutrient preparations over mega doses of individual nutrients (Atalay et al., 2006). A nutrient-dense diet, that includes whole grains, fruits, vegetables, nuts and seeds can help provide dietary sources of antioxidants.

Jumpers, throwers and combined events athletes put tremendous stress on their joints. Nutrition can play an important role in supporting joint health. Key nutrients important for healthy joints include: protein, calcium, phosphorus, zinc, vitamin C, vitamin D and vitamin E (Clark, 2007). Including more omega-3 fatty acids and collagenous materials (i.e., meat) in the diet can also promote joint health (Clark, 2007). Several joint health supplements are available and can be appealing to athletes who suffer from joint pains. Currently, the most popular supplements are glucosamine sulfate and chondroitin sulfate. A meta-analysis of placebo-controlled trials in osteoarthritic populations, not specifically athletes, using these two supplements concluded that while joint pain symptoms may have been reduced following supplementation, the effects were likely exaggerated (McAlindon, LaValley, Gulin and Felson, 2000). A review of joint health supplements and herbs used in other populations has been recently published (Clark, 2007) and concluded that more research is needed before optimal joint health supplement recommendations can be made. For the athletes today, what this means is focusing first on eating foods that provide nutrients needed for healthy joints.

Other supplements and ergogenic aids that effectively improve speed, strength, and power can potentially benefit jumpers, throwers and combined events athletes. These supplements include creatine, sodium bicarbonate, and caffeine. Sodium bicarbonate does not appear to provide benefits for jumpers or throwers, but may improve performance in events from 400 m to 5000 m, and thus may benefit combined events athletes (Maughan et al., 2007). Athletes need to be aware of the potential for contamination of vitamin, mineral and other dietary supplements with banned substances which can lead to inadvertent doping. Issues regarding the principles and general evidence for effectiveness of specific supplements (including creatine, bicarbonate, and caffeine) have been summarized by Maughan et al. (2007). Additional nutritional strategies to promote recovery and adaptation from training are discussed in the articles by Hawley, Gibala and Bermon (2007) and Burke et al. (2007).

**Nutrition for Competition Periods**

Planning nutrition support during competition periods is an important part of preparation for all of these athletes and especially for the combined events athletes because they spend two full days competing without much down time.

**Timing of fluid intake.** Fluid intake should start long before the first event and be individualized for each athlete. Fluids should be consumed about 4 hours and 2 hours before warm-ups and events (Shirreffs et al., 2004; American College of Sports Medicine, 2007). Also important, is leaving time to use the restroom before competition since most events do not allow for bathroom breaks. Jumpers, throwers, and combined events athletes all participate in events that consist of bouts of short duration exercise (< 6-8 minutes) spread out over longer time periods. This schedule allows the athlete ample opportunity to hydrate before and after events to minimize dehydration. When this down-time occurs outdoors in hot environmental
conditions it can lead to dehydration unless adequate amounts of fluids and sodium are consumed. Over consumption of fluids during down-time can also lead to hyperhydration which can have negative impacts on performance (Shirreffs et al., 2007). Athletes should be careful to not drink excessive amounts of fluid that result in hyperhydration and weight gain on competition days. Athletes need to plan for fluid access at competitions and follow an individualized drinking schedule for fluid intake throughout their competition schedules to prevent dehydration and hyperhydration.

When exercise is strenuous, performed in extremely high temperatures or humidity and/or lasts longer than 60-90 minutes (accumulated time competing), a fluid with carbohydrate and electrolytes, like that found in sports beverages, should be consumed. The electrolytes (mainly sodium and potassium) in a typical carbohydrate-electrolyte sports beverage aid in the absorption of fluid while carbohydrates supply additional energy (Shirreffs et al., 2004). Overall, for most athletes a cool temperature and appealing flavor help enhance fluid consumption.

Fluid and electrolyte intake during competition days, as well as training sessions, can help reduce the risk for heat cramps. Heat cramps are most prevalent in active muscle like the thigh and calf (Ganio et al., 2007), thus athletes using these muscle groups can be at increased risk for heat cramps when hydration strategies are not appropriate. The origination of heat cramps is not clearly known, however, large fluid and sodium losses have been implicated (Ganio et al., 2007). Athletes, therefore, need to focus on not only replacing fluid losses during exercise, but also sodium lost through sweating. Simple strategies of packing sodium-containing fluids and/or snacks (e.g., crackers, pretzels, sports drinks) and consuming these during competition can help prevent heat cramps.

Recovery after competition includes not only rest but rehydration and refueling. This is particularly important for combined events athletes, because they compete in five to ten events spread over two days. These multiple events put the athlete at increased risk for dehydration and decreased performance on the days of competition and particularly at the end of the day in hot environmental conditions. Therefore, combined events athletes need to rehydrate between events (Ganio et al., 2007). Generally, these athletes need to consume about 1.5 l of fluid for each kg of weight lost over the day of competition with the goal of returning to pre-competition weight (Shirreffs et al., 2004, American College of Sports Medicine., 2007). In addition to volume, these athletes also need to focus on electrolyte replacement, mainly sodium. Some research supports that rehydration may be enhanced by consuming beverages after exercise that contain higher sodium concentrations than those found in sports drinks formulated for consumption during exercise (Shirreffs et al., 2004). In-depth information on this topic has been summarized by Shirreffs et al. (2007) and in an American College of Sport Medicine position paper (2007).

**Timing of food intake.** It is generally recommended that the pre-exercise meal be consumed 1-4 hours prior to onset of exercise and be high in carbohydrate, containing around 1 - 4 g of carbohydrate·kg\(^{-1}\) of body weight (Burke, 2007; Hargreaves et al., 2004). With early morning start times for some competitions, not every athlete will wake 3 to 4 hours before competition. For these circumstances, athletes delay the consumption of a pre-competition meal to within the hour prior to starting
competitions (Hargreaves et al., 2004; Jeukendrup, 2004). When this is the case, the pre-competition meals should be mainly carbohydrate, familiar foods, and well tolerated so as not to cause gastrointestinal distress.

As time spent competing accumulates to longer than one hour, carbohydrate should be consumed to replenish glycogen stores and keep energy levels high (Maughan and Burke, 2002; Jeukendrup, 2004). This carbohydrate can be consumed in solid form, if available, or as part of a sports drink. For some athletes, foods with a lower glycemic index may be better tolerated.

Post-competition meals are important for fluid and carbohydrate fuel replacement needed for recovery from competitions. To maximize performance, athletes need to actively plan and make arrangements to have suitable beverages and foods available before and after events and after the day of competition.

**Translation of Nutritional Recommendations into Practice**

Planning and practice are key elements to effectively using nutrition guidelines to help optimize individual nutrition plans for jumpers, throwers and combined events athletes. Applied sports nutrition manuals and books provide practical sports nutrition information for coaches and athletes (Burke, 2007; Maurer 2004; Houtkooper, Maurer Abbot and Mullins, 2007). It is important to maintain flexibility when planning fluid and food intake during competitions and make adjustments in response to changes in environmental conditions.

**Summary**

Combined events athletes, throwers and jumpers require speed, strength, power and a wide variety of technical skills to be successful in their events. There are limited studies assessing the nutritional needs of these athletes. Due to this limitation, recommendations for nutritional requirements to support and enhance training and competition performances for these athletes need to be individualized using research findings from sports and exercise protocols that are similar to their training and competition events. It is also important to recognize the individual variability in responses among these athletes when applying these guidelines during training, competition and transition periods under varied environmental and psychological conditions.

**Recommendations for:**

- Food and fluid intakes need to be individualized for each athlete because nutrient needs vary with body weight, periods of training preparation, competition schedules, transitions and the off-season
- Changes in body weight and composition should be attempted before or after the competition season
- Fluid losses should be limited to <2% reduction of euhydrated body weight by consuming appropriate amounts of fluid before, during and after exercise
- The athlete should rehydrate after exercise training and at the end of competition days by consuming enough fluid and sodium to replace body fluid and sodium losses and to have a pale yellow colored urine
- Protein and carbohydrate needs vary with individual body weight and with the intensity and duration of training periods
• Protein and carbohydrate needs, even for high intensity and long duration strength training exercise loads, can be met by food sources.
• Protein supplements provide convenient sources of protein but the protein is not superior to the protein in foods.
• During training sessions of moderate-intensity or intermittent exercise that lasts longer than one hour consuming carbohydrate will help replace glycogen stores.
• Following exercise, consuming adequate amounts of carbohydrate will speed up the rate of replacement of glycogen stores.
• Dietary Reference Intakes for vitamins and mineral should be attained.
• Dietary supplements that have demonstrated efficacy can improve speed, strength, and power can potentially benefit performance.
• Translating research based recommendations for nutrient intakes into practical plans that athletes actively apply during training, competition, transition and off-season periods can help enhance performance.

Equivocal Issues:
• The benefit of protein to aid glycogen resynthesis when intervals between events are short.
• That dietary antioxidant supplementation or other nutrient supplements will improve performance unless there is a deficiency of the nutrient.

Recommendations Against:
• Indiscriminate use of nutrient supplements and ergogenic aids.
• Excessive fluid intake that leads to hyperhydration and weight gain during a competition day.

REFERENCES


Table 1. Age, Height, Weight, and Body Composition of Elite Female and Male Throwers, Jumpers and Combined Event Athletes

<table>
<thead>
<tr>
<th>Sport</th>
<th>N</th>
<th>Age (y)</th>
<th>Ht (m)</th>
<th>Wt (kg)</th>
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<td>63.3</td>
<td>19</td>
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*Fat mass estimated using Brozek equation (1963);%Fat estimated using Durrin and Womersley equation (1974);%Fat estimated using Jackson & Pollack 3-site equation (1980);Body density estimated using equation by Sloan (1962);%Fat estimated using Siri equation (1956);%Fat estimated from Sloan equation (1962);DXA, Lunar 1.3 years. Fat Free Body Mass Index (FFBMI) = FFM (kg) / Ht (m) squared.

Adapted from Houtkooper et al., 2001.
Table 2. Average Daily Macronutrient Intakes of Throwers, Jumpers and Combined Events Athletes

<table>
<thead>
<tr>
<th>Sport</th>
<th>N</th>
<th>Age (y)</th>
<th>Energy (kJ)</th>
<th>CHO %kJ</th>
<th>g</th>
<th>PRO %kJ</th>
<th>g</th>
<th>Fat %kJ</th>
<th>g</th>
<th>Method of assessment</th>
<th>Calibre of athletes</th>
<th>Reference</th>
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<td>21-29</td>
<td>9866</td>
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<td>16</td>
<td>95</td>
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<td>71</td>
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<td>Elite</td>
<td>Mullins et al 2001</td>
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<td>82</td>
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<td>3-day record</td>
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<td>Sugiura &amp; Kobayashi 1998</td>
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Adapted from Mullins et al. 2001