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Dietary Recommendations for Athletes with Disabilities

by Judith Haudum, MS

Over the past 30 years, athletes with disabilities have been making history in the world of sports. Although physical activity was once used solely for therapeutic and rehabilitative purposes among this population, it has moved from being a means to an end to being an end in itself as a growing number of individuals with disabilities engage in competitive athletics. This increase in sports participation has raised interest in and support for athletics for the disabled. Today professional associations worldwide allow athletes with disabilities to participate in various disciplines—for example, tennis, basketball, track and field, marathon, and winter sports—at a high level, and in some countries media coverage of disabled sports has expanded beyond simply covering the Paralympic Games.

Despite this increased participation and attention, sports for the disabled still lack qualified personnel to provide coaching, training, and nutrition counseling. Research in this field is limited and there is a paucity of evidence-based recommendations, particularly in the area of nutrition.

This article summarizes the limited research pertaining to the nutritional requirements and recommendations for athletes with disabilities. Because most of the available research focuses on spinal cord injuries (SCI), this article primarily addresses this group of athletes. As a matter of background, athletes with SCI are classified as paraplegic or tetraplegic, according to the extent of spinal cord damage. The damage that results in a loss of function is referred to as a lesion. Tetraplegia is paralysis in the cervical (neck) region; paraplegia is paralysis in the thoracic, lumbar, or sacral region.

Physiologic and Metabolic Effects of SCIs: Implications for Athletic Performance

Individuals with SCI injuries face many physiologic and metabolic changes post-injury.[1] Of special interest to athletes and their fitness/nutrition advisors are alterations in cardiac output, maximal oxygen consumption (VO_2max), and thermoregulation, because they all directly impact athletic performance. In contrast to athletes who have other disabilities (e.g., mental retardation, amputation), SCI athletes experience a reduction in overall aerobic capacity. Alterations in the sympathetic nervous system lead to changes in VO_2max and, hence, a decrease in cardiac output.[2] This decrease causes an impaired capacity to transport oxygen throughout the body, ultimately resulting in a lower VO_2max. Reduced VO_2max is particularly evident in athletes with tetraplegia due to the high location (level) of their lesion on the spinal cord.[3]

Several studies have examined VO_2max and substrate utilization at different exercise intensities in wheelchair athletes.[4-6] Compared with able-bodied (AB) controls, VO_2max has been shown to be lower among wheelchair athletes. In addition, SCI athletes seem to rely more on carbohydrate (CHO) than fat in comparison to able-bodied counterparts at the same relative intensity.[4,5] Although CHO utilization among paralyzed athletes increases with intensity (and fat utilization decreases), maximal fat oxidation appears to occur at a slightly lower intensity in SCI athletes compared with able-bodied athletes. Knechtle and colleagues found that wheelchair athletes demonstrated the highest rate of fat oxidation at 55% VO_2max, which is considerably lower than the typical fat oxidation peak seen in able-bodied athletes (65% VO_2max).[5] The mechanism for this difference in substrate oxidation has not been elucidated, but it has been hypothesized to be due to impaired neural activity in motor centers and afferent nerves from working muscles that inhibits fatty acid oxidation and shifts main substrate utilization toward CHO.

Regardless of the mechanism, the implications are clear: considering that most SCI athletes compete at 70% VO_2max,[6] carbohydrate is clearly the predominate fuel utilized during endurance exercise in these athletes.[7] In addition to increased utilization, there is the issue of CHO storage capacity in SCI athletes. Given the smaller muscle groups involved in wheelchair sports (i.e., arms versus legs), there is a more limited capacity for CHO storage and a greater likelihood for glycogen depletion during exercise. For this reason, CHO ingestion, especially *during* prolonged exercise, becomes very important.

Another physiologic change that has nutritional implications is a diminished sweating capacity and vasomotor regulation below the spinal cord lesion.[2,3,8] Paraplegic athletes have been shown to have similar skin temperatures compared with able-bodied athletes, but aural temperature remains elevated in paraplegic athletes during recovery,[8] perhaps due to fewer innervated areas and less sweating. Sweat capacity appears to be positively related to lesion level.[3] Tetraplegic athletes have a lower sweating capacity than paraplegic athletes and, hence, the smallest capacity for heat loss. Price and Campbell[8] examined fluid intake in SCI athletes and found that in addition to substantial differences in thermoregulation, tetraplegic athletes consumed significantly less fluid during exercise compared with paraplegic and able-bodied athletes. Interestingly, paraplegic and able-bodied athletes did not differ in fluid intake or fluid loss. Thus, while it is important to ensure adequate fluid intake among all SCI athletes, special attention should be paid to the fluid consumption habits of tetraplegic athletes to avoid heat illenesses and optimize performance.

Recent research indicates that levels of inflammatory markers such as C-reactive protein, interleukin-6, and endothelin-1 are elevated in individuals with SCI.[9,10] The precise mechanisms underlying the increases in inflammatory markers has not been fully elucidated, but it has been postulated that the frequent urinary tract infections and pressure ulcers experienced by SCI athletes might be partially to blame. Although there is little research to support the use of antioxidant supplements in SCI patients, it would seem prudent for SCI athletes to consume a diet (i.e., food) rich in antioxidants and omega-3 fatty acids.

" CHO ingestion, especially *during* prolonged exercise, becomes very important."

A final physiologic consideration pertains to bone health. Research suggests that SCI athletes are at greater risk for low bone mineral density (BMD) and osteoporosis.[11-13] Physical activity, particularly that which "loads" the bone, stimulates bone formation and helps prevent loss of BMD.[12] Wheelchair athletes face a double insult to bone health: not only does being in a wheelchair limit weight-bearing activity but the inability to use the lower limbs negatively impacts lower-body BMD. Studies have shown a significant decrease in BMD of the entire body among SCI patients, especially during the first months following spinal injury.[11-13] Nonetheless, some research suggests that early engagement in sports activities may attenuate the bone loss in SCI individuals, especially in comparison to SCI individuals who do not exercise.[12] Moreover, wheelchair users seem to have higher BMD in their arms compared with able-bodied athletes, likely due to greater use of their upper bodies in daily life. It also appears that the increased upper body use among wheelchair users positively impacts lumbar spine BMD.[11] As is true for thermoregulation, the degree of spinal cord injury appears to affect BMD, as individuals with tetraplegia experience greater BMD losses than those with parapalegia.[12] To compound the problem, research suggests that many SCI patients have inadequate intakes of calcium and vitamin D,[13,14] which may further compromise bone health and increase fracture risk.

Nutritional Status of Athletes with Spinal Injuries

Little is known about the usual dietary intakes and nutritional status of athletes with disabilities, making it difficult to determine if they are generally meeting their needs. Rastmanesh and colleagues examined the dietary practices of wheelchair athletes and observed little nutrition knowledge but high interest in nutrition education among these athletes.[14] Data from completed nutrition questionnaires indicated an average daily energy intake of 1,690 ± 490 kcal and high protein (PRO) consumption, with PRO levels twice as high as recommended for able-bodied athletes. Also, the diets of wheelchair athletes were low in calcium, vitamin C, vitamin D, and fiber. Fiber consumption is important for SCI patients because many have low bowel motility due to low mobility; therefore, adequate dietary fiber could help prevent constipation in this population.[3]

Potvin and colleagues[15] studied the

usual dietary intake in 10 wheelchair endurance athletes. Mean daily energy intake was 2,140 ± 490 kcal, which represents about the typical intake of female dancers and distance runners. Protein intake among the athletes averaged 1.6 g/kg. Only 47% of the diet consisted of CHO, which is less than the amount recommended for athletes. Micronutrient intakes were adequate with the exception of zinc and vitamin E.

"Mean daily energy intake was 2,140 ± 490 kcal, which represents about the typical intake of female dancers and distance runners."

Nutritional Recommendations

Because most athletes with disabilities have lower energy requirements than their able-bodied counterparts, it is important that their diets be nutrient-dense. Furthermore, because CHO is the primary substrate utilized during exercise, disabled athletes should consume a diet rich in CHO and ensure that they consume CHO-rich foods before, during, and after exercise. Particular emphasis should be placed on those nutrients shown to be low in the diets of disabled athletes: calcium, zinc, vitamins D, E, and C, and fiber. Furthermore, foods rich in antioxidants (carotenoids; vitamins A, C, and E; the B vitamins; and zinc), and other anti-inflammatory nutrients such as omega-3 fatty acids should be emphasized in the diet of disabled athletes.

Based on the physiologic and metabolic changes described in this article, along with current knowledge regarding dietary intakes and nutritional status of SCI athletes, the following nutritional recommendations can be made:

- Because of the lower energy needs of SCI athletes, a nutrient-dense diet should be emphasized to avoid nutrient deficiencies.
- Adequate CHO intake prior to and during exercise is crucial to maintain and optimize performance in SCI athletes. Usual CHO recommendations for able-bodied endurance athletes (6-8 g/kg per day) would seem to be reasonable for this group of athletes to meet their CHO needs.
- Protein intakes of SCI athletes appear to be somewhat excessive (and may end up displacing CHO and essential fatty acids from the diet). To ensure the proper macronutrient distribution, protein intakes should not exceed 15% of total energy intake.
- Given the impaired thermoregulatory capacity, fluid consumption during exercise is important. However, many athletes have to plan toileting and incorporate it into their schedule according to their sport. Dietetics practitioners must be aware of and talk to their athletes about potential problems in bladder control. Athletes who have poor control should learn about fluid intake and toileting during their training.
- Due to a diminished sweating capacity, cooling devices should be available to help regulate temperature and prevent heat stroke as well as decreased performance.
- To minimize bone loss after SCI, dietary sources of "bone nutrients"—particularly calcium and vitamin D—should be emphasized.
- Spine injury, locomotion, and continuous stress on the body lead to an increase in inflammatory markers. Dietary sources of antioxidants and omega-3 fatty acids should be emphasized to improve immune function and lower levels of inflammatory markers.
- Because wheelchair athletes often experience constipation due to slow bowel motility, foods rich in fiber should be emphasized in the diet.

As always, every attempt should be made to address any nutrient deficiencies with food. If the athlete is unable or unwilling to meet his or her needs with food, supplements may be warranted (e.g., a calcium and vitamin D supplement to ensure optimal intake for bone health).

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